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DEPARTMENT OF THE AIR FORCE
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AFIT/GEM/LSM/90S-7

A PERFORMANCE MANAGEMENT FRAMEWORK
FOR CIVIL ENGINEERING

THESIS

Robert Michael Gill

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The opinions and conclusions in this paper are those of the author and are not intended to represent the official position of the DOD, USAF, or any other government agency.

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THESIS

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Abstract

A performance management team was implemented at the Engineering Branch of the 2750 Civil Engineering Squadron at Wright-Patterson Air Force Base. The team focused on the process of reviewing projects designed by architect-engineers and the Corps of Engineers. As a result of this team effort, improvements to the process were made such as More timely and better comments were being provided to the designers after the improvement actions.

From the experiences gained in the analysis of this case, a three day training course was developed. This course was created to provide the tools and attitudes needed to begin performance management efforts in other Engineering Branches. The course was designed to provide a starting point, and as a guide to the performance management effort.

The course was structured to be presented at the squadron location, in order to teach people in their own environment. Topics included were the distinctives of the engineering environment, understanding the process framework, the use of measurement in evaluating work processes, and employee participation. The use of the course was recommended for the base level Engineering Branch. [illegible] Management engineering [illegible]; Architects, engineering productivity; Army Corps of Engineers; [illegible] training; quality assurance; Performance engineering; (MM)

A PERFORMANCE MANAGEMENT FRAMEWORK FOR CIVIL ENGINEERING

I. Introduction

General Issue

The Department of Defense has recognized the potential for benefits from the implementation of Total Quality Management (TQM) concepts in military organizations. To achieve these benefits the Secretary of Defense has instructed military organizations to implement TQM (Department, 1989b:2). Air Force Civil Engineering Squadrons are among the organizations affected by this instruction. Direction is needed regarding how to accomplish this implementation in a Civil Engineering Squadron, as well as guidance in the type of benefits to be sought.

TQM is gaining great publicity in organizations throughout the country. Most of this exposure, however, is in manufacturing. Service organizations, such as a Civil Engineering Squadron, have needs and goals which differ from their manufacturing counterparts. Likewise, application of TQM in military and government organizations will encounter different obstacles than in private organizations where profit is the goal. To be used successfully, the TQM concepts need to be adapted to the unique nature of an Air

Force Civil Engineering Squadron. To differentiate the management philosophy needed for civil engineering from TQM, the term performance management will be used to describe the attitudes, tools, and framework needed to direct improvement efforts in this setting.

Background

> Government and industry have come to understand that previously acceptable norms of goods and services are no longer acceptable. Customer satisfaction, reliability, productivity, costs, and for industry, market share, profitability, and even survival are directly affected by the quality of an organization's products and performance. Therefore, it becomes essential to develop attitudes and systems -- at all levels of an organization -- that promote and implement continuous improvement of procedures, processes, products, and services. Those attitudes and systems are the focus of Total Quality Management (TQM). (Department, 1989a:2)

The drive for performance management can be summed up in the old adage, "an ounce of prevention is worth a pound of cure." For too long managers both within and outside of government have been content to let well enough alone and only act when problems became apparent. A performance management framework must emphasize the importance of analyzing the status of performance today and seeking to improve it for tomorrow (Department, 1989a:8).

The kind of perspective management needs is one which is future oriented. Quality provides just such a perspective. Quality is an important ingredient in overall performance. When managers make the quality of their products and processes the target of their efforts, they are looking toward being competitive in the future as well as today (Townsend and Gebhardt, 1989:20). Quality products are products which endure, ensuring that there will be demand for such products long after other competitors have disappeared.

The Old Philosophy
If it ain't broke, don't fix it.

The New Philosophy
An ounce of prevention is worth a pound of cure.

Figure 1. Philosophy Change for Performance Management

Performance improvement is an ongoing process. There is never a point where the concerned manager can realistically say "this is as good as it can get." At any given time, there will always be improvements which can yet be made. Managers need to make a commitment to scrutinize the activity of organizations continuously to determine where additional improvements might be made. When one of these improvements is implemented, attention needs to be given to other aspects of performance which can also be made better. (Roth, 1989:26)

Among profit-making companies, it has been declared that quality is the proposal which affects the profits of a company most. In fact, it has been estimated that the cost to American companies due to inferior quality is in excess of thirty percent of their gross sales (Townsend and Gebhardt, 1989:18). This alarming figure is a direct challenge to improve quality. The government organization should not consider itself an exception. While not having profit as a measure for quality of performance, untold resources are squandered due to poor quality. This waste results from rework after poor initial work, and from inefficiency of operation.

Performance management has three principal orientations by which organizations are encouraged to pursue quality: 1)customer orientation; 2)process orientation; 3)participation orientation. First, the customer orientation forces identification of the internal and external customers of the organization. Satisfaction of these customers then becomes the measure of quality in this orientation (Department, 1989a:6-7). Internal customers are those within the organization who receive output from the particular unit. For example, when the engineering department prepares a drawing showing the maintenance department how to install a new component, the maintenance personnel are internal customers of the engineering department. External customers are those outside the organization which receive output or products. The organization then sets better service to these customers as a goal (Kacker, 1988:40). For an engineering company in particular, the degree to which it meets obligations and promises to clients (customers) is indicative of commitment to quality (Armentrout, 1986:144).

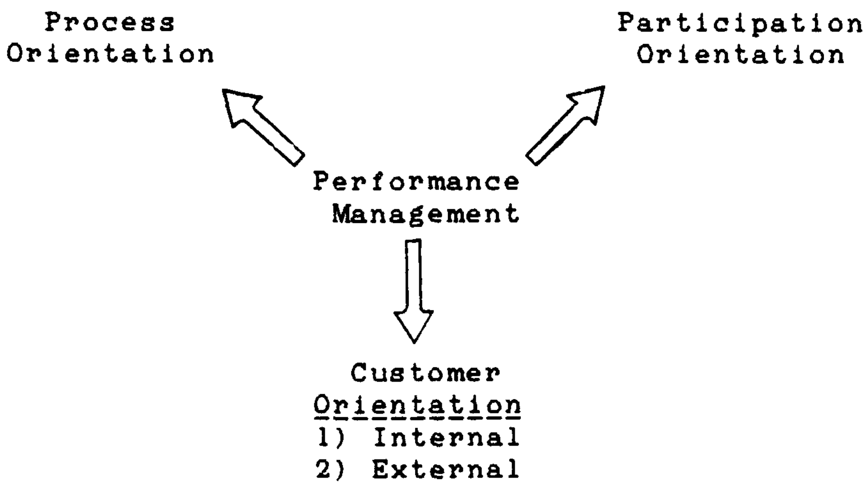


Figure 2. The Viewpoint of Performance Management

Secondly, performance management stresses a process orientation. The processes which comprise the business of the organization are the emphasis for improvement . This requires identifying these processes, and determining who is responsible for their successful completion (Kacker, 1988:41). Opportunities for improving the way these processes are done are identified, no matter how small. It is the combination of these small improvements which will eventually produce significant results (Department, 1989a:10-11). For example, the engineering branch may identify the review of design drawings for new buildings as one process for which the Chief of Design is the person in charge. This design review process would then be examined for potential improvements.

Finally, performance management needs to be participation oriented. The basis for this is that no manager has all the best ideas. The input of the workers involved, those closest to the action, must be included to truly achieve the performance improvements desired. When employees become aware that their ideas are being listened to, they will want to contribute. Listening to what they have to say will be beneficial (Department, 1989a:14). Using such a participative approach with engineers is especially productive, due to the training and talents that these individuals typically have (Stewart and Calloway, 1982:113). Engineers are familiar with the problem solving process used in their design work. The management skills engineers gain in leading design teams is also an advantage.

Specific Problem

Previous research has examined the initial implementation of TQM in the Operations and Maintenance Branch of a Civil Engineering Squadron (Wertz, 1989). This research will pursue a subject suggested by this previous research: Development of a training course and handbook detailing a method to implement a performance management framework in the Contract Engineering Branch. The design and steps to implement such a framework in the Engineering Branch at Wright-Patterson AFB, Ohio will be documented. The change in attitude toward quality accompanying this implementation will be measured using a quality survey. This will help evaluate the degree to which a transformation of viewpoint is needed before performance management can be effective.

The Contract Planning and Engineering Branch of an Air Force Civil Engineering Squadron (Engineering Branch) is responsible for planning, designing, and supervising the contractual performance of projects which maintain or improve the physical plant of an Air Force base. This

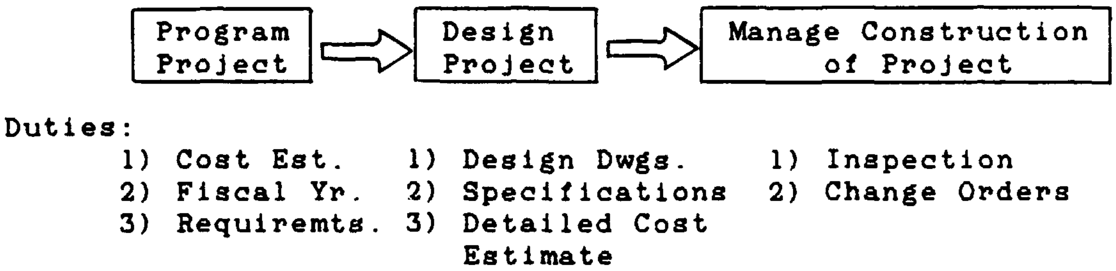


Figure 3. The Contract Project Process

physical plant includes the roads, utilities, facilities, and grounds. A significant difference between the Engineering Branch and the Operations and Maintenance Branch previously studied is that the Engineering Branch employs more professional and technical personnel, whereas the Operations Branch employs more craftsmen and administrative people. While both have a service orientation, this difference in personnel may lead to differences in use of the performance management concepts. This research will not repeat the efforts of the previous research. Rather, a framework for the implementation of performance management specifically tailored to the Engineering Branch of Air Force Civil Engineering will be developed.

Justification and Purpose

The Department of Defense (DoD) has been instructed to implement TQM across all organizations in the armed forces (Department, 1989b:2). This approach to management has been found to produce significant improvement of job satisfaction among workers, productivity levels, cost reductions, and customer satisfaction. The Japanese were the first to adopt TQM on a large scale and to demonstrate its potential (Walton, 1986:25-32,122-123). The United States Government, recognizing the benefits to be gained for its own military, decided to have federal organizations initiate such management programs. Air Force Civil Engineering is thus responsible to accomplish this transformation within its own ranks. The TQM concepts must be adapted into a framework for performance management tailored to the civil engineering environment.

This research will closely examine the actual implementation of a performance management framework in an Air Force Civil Engineering environment. It will document the steps taken, the difficulties encountered, and the results obtained. A training course and handbook will be developed specifically designed for the Engineering Branch to aid in the implementation of performance management. This research will further measure the extent, if any, to which the attitudes of the personnel associated with this implementation in the squadron are altered toward their role in performing well. The extent of any improvements in the processes underlying the work of the squadron will also be documented.

Table 1. Research Goals

1) Document and analyze the implementation of performance management.

2) Develop a training course and handbook to aid in efforts to implement performance management in other engineering branches.

3) Measure any change in attitude toward quality accompanying implementation of a performance management framework.

This information should prove valuable to Air Force Civil Engineering managers preparing to implement performance management in their own organizations. In addition, a statement can be made of how effective the implementation is in the target Civil Engineering Squadron. To the extent allowed by the research method adopted, this information may be extended to the potential effectiveness of performance management in other squadrons. This information will be the foundation for a training course and a handbook, recommending methods and options for implementing a performance management framework. This training course and handbook will facilitate the use of the lessons learned in this research.

Scope and Limitations

The target for research is the Engineering and Contract Planning Branch of an Air Force Civil Engineering Squadron.

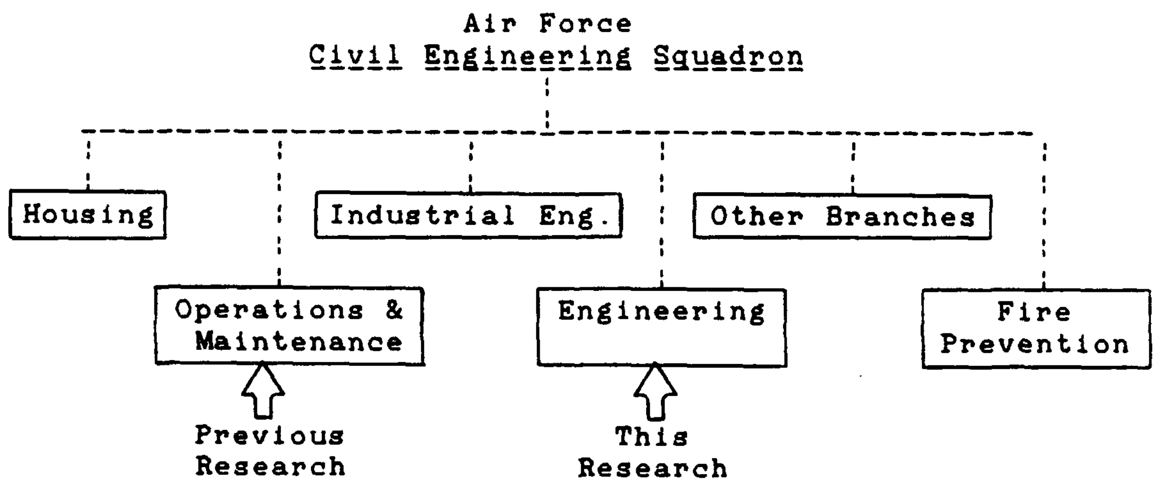


Figure 4. Civil Engineering Organizational Chart

Research regarding implementation of TQM in the Operations and Maintenance Branch was previously performed (Wertz, 1989). Housing, Industrial Engineering, and other branches will not be addressed. The Engineering and Contract Planning Branch is the largest of the branches not included in the previous research, and has therefore been chosen as the next branch to be concentrated on. In addition, the researcher is familiar with the working of this branch, facilitating this research.

Investigative Questions

In order to accomplish the purpose for this research, the following specific questions will need to be answered:

1. How has TQM been utilized in other similar organizations? What benefits have been achieved? What changes need to be made to adapt TQM to the Contract Engineering Branch?
2. What opportunities and needs exist within the Engineering Branch for improvement?
3. What training of personnel is used prior to or during implementation of TQM?
4. What obstacles are encountered during the initial implementation of TQM?
5. What short range benefits can be measured after implementation of TQM?
6. What outside resources (i.e. private contractors or procured training) are needed to facilitate the performance management effort?
7. How do attitudes toward quality of work change among employees involved in performance management?
8. How is a performance management framework used to guide improvement efforts in the particular situation of an Engineering Branch?
9. What guidance do Engineering Branch managers need to design and implement a performance management framework in their organizations?

Organization of Presentation

Chapter I presents the introduction to the subject for research and a description of the problem and investigative questions. The purpose and scope are given.

Chapter II presents a review of the literature pertinent to the subject of research. The chapter is divided into topics relevant to performance management and its implementation in an engineering environment.

Chapter III describes the methodology used to answer the investigative questions. Reasons for selecting the particular methodology are also given.

Chapter IV summarizes the data obtained through the research. Tables are included to consolidate the results.

Chapter V explains the results and draws appropriate conclusions from the data, and makes recommendations for further research.

Summary

Performance management is a framework of attitudes and tools for managers to use to increase the performance of their organizations. It stresses customer satisfaction, process improvement, and employee participation. Air Force Civil Engineering Squadrons have been instructed to implement TQM to make better use of the scarce resources available and to better accomplish their mission of facility support. This research will examine and document the implementation of the TQM concepts in a Civil Engineering Squadron environment, record the associated results, and propose a training course and handbook to assist managers in implementing a framework for performance management in their squadrons.

II. Review of Literature

Overview

This chapter will discuss current published information on the subject of implementing a system for performance analysis, improvement and management. Much of this literature focuses on Total Quality Management (TQM) and its use in organizations similar to civil engineering. TQM is a management philosophy which stresses continuous improvement of the processes which make up any organization's work.

Several issues must be resolved in order for performance management to be successfully implemented in an organization. Information will be presented pertaining to these issues, which are

1. Engineering Environment Distinctives/Difficulties
2. Target of Improvement
3. Measurement
4. Degree of Employee Involvement
5. Extent and Nature of Training
6. Management Commitment
7. Process Improvement
8. Implementation

Engineering Environment Distinctives/Difficulties

Improvement in the engineering design of construction projects has not received the attention that improvement in manufacturing production techniques has. Total Quality Management principles have the potential for astounding increases in productivity, quality, and labor motivation in the manufacturing environment. One estimate suggests that no less than 65% of a service industry's production is lost to extra steps in the work processes needed to correct errors (Kacker, 1988:40). Yet the potential exists to use TQM for greatly increasing productivity and decreasing cost through better designs.

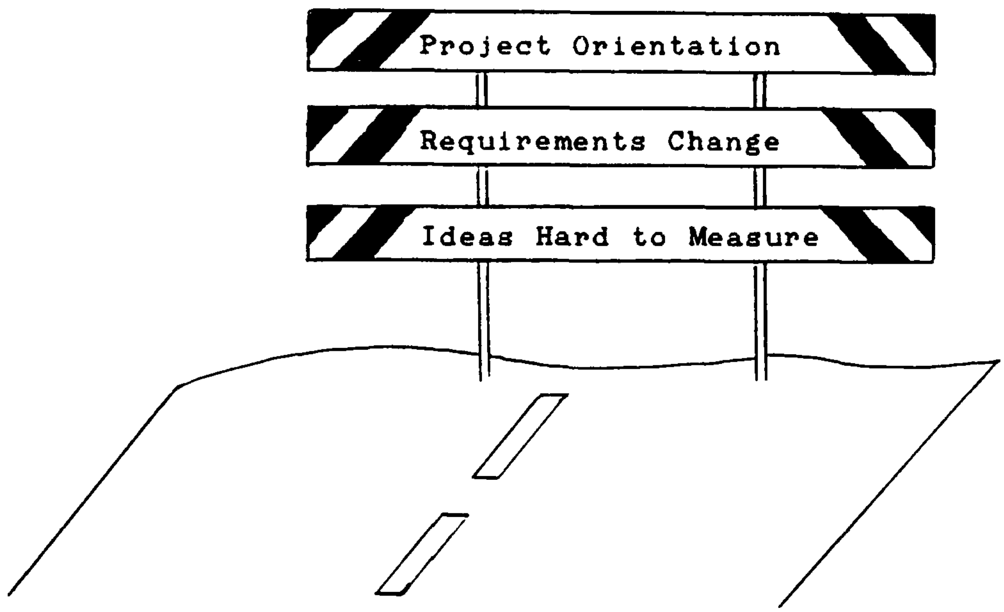


Figure 5. Roadblocks to Performance Management

The literature reveals many obstacles preventing wider use of TQM. Construction and design are oriented toward individual projects, inhibiting improvements from being shared from one project to another. The frequency with which owners or users change their minds about what they want makes it difficult to accurately evaluate the effectiveness of the design itself (Gilly and others, 1987:428,430-1). Another impediment is that engineering design initially provides information. When the output of the work is a physical object which can be counted and inspected, evaluation of the output is simplified. It is much more difficult to objectively evaluate a conceptual design: against what standard should it be measured (McGeorge, 1988:360)?

Target of Improvement

Focus of Improvement. By its very name, one would surmise that the focus for improvement of total quality management is quality. But what is quality? And is that indeed the focus? The Department of Defense, when mandating TQM, defined quality as the degree to which the customer is satisfied (Department, 1989a:7). Quality in the civil engineering environment is further defined as meeting the declared requirements of the owner, designer, constructor, and regulating bodies (ASCE, 1988:1). Above all others,

Improved Performance	+	Customer Satisfaction	=	Quality Management

Figure 6. The Performance Management Equation

quality is the greatest single factor which affects the profitability of a concern (Townsend and Gebhardt, 1989:18). While improving the quantity of production is important, the quality produced in engineering work is most important (Takei, 1981b:24).

Productivity, being the ratio of output produced to the corresponding input used, is proposed as an alternate focus of improvement (Stewart and Calloway, 1982:110, Sumanth and Yavuz, 1983:260). In his work to improve engineering productivity in the Tennessee Valley Authority, Daryl Armentrout suggests the broader index of performance is another possible focus for improvement. Performance includes efficiency, effectiveness, profit, innovation, and working conditions in addition to quality and productivity. These seven components of performance are equally applicable to not for profit public agencies. Profitability must be changed to budgetability, defined as the degree to which the organization accomplishes its goals and objectives and keeps its budget (Sink and Tuttle, 1989:185). The measure of effectiveness is given as how well commitments to the customer are satisfied (Armentrout, 1986:142,144). This then comes back to customer satisfaction as suggested by DoD.

Table 2. Components of Performance

Effectiveness
Quality
Efficiency
Productivity
Quality of Work Life
Innovation
Budgetability or Profitability

Lieutenant General John M. Loh, as Commander of the Air Force Aeronautical Systems Division, lists "delighting the customer" as one of the guiding principles of that organization. He includes the contractors retained by the Air Force among those customers. The engineering designs and documents prepared by the government are the product that needs to be improved to satisfy that customer (Loh, 1989). Another customer for the engineering organization is the field worker (Takei, 1981b:23). It is imperative that the needs of these customers, as well as those of the ultimate users of the facilities, be identified and goals set to satisfy these needs (Kacker, 1988:40).

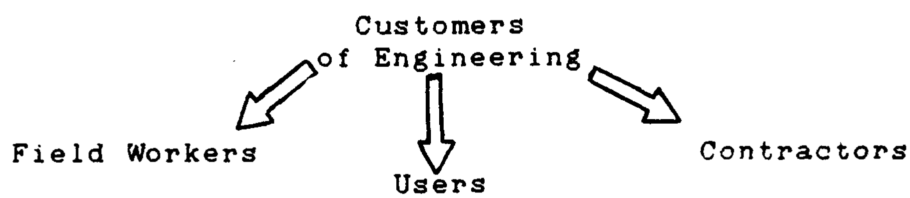


Figure 7. Civil Engineering Customers

Method of Improvement. The obstacles to performance management implementation in the engineering environment discussed above need to be overcome for the effort to be effective. The engineers themselves are the most effective resource in overcoming these obstacles. One suggestion is to establish a team of engineers to develop quality and productivity improvements. The team determines the critical factors affecting the work, and establishes a theme or goal for improvement. A measurement formula must then be devised to provide data for planning the improvement method. Once appropriate and meaningful measures are established, methods are attempted to improve the system until success is achieved. Then a new theme for improvement is decided upon and the steps repeated (Takei, 1986:93).

Measurement

Establishing Meaningful Measures. Measuring the productivity or quality of an engineering concern is difficult. The output of engineering is often one of ideas, a product not easily quantified. An ideal product measure would be to relate total output to all associated input (Sumanth and Yavuz, 1983:261). This total factor ratio should be applied where costs permit. However, attaining this kind of total measure may not only be expensive, it may be impossible due to the inability to assign the engineer's input (time) to a particular output. Two other levels of measurement are partial factor and single factor ratios. A single factor ratio is developed by selecting some lone factor believed to accurately represent the total input or output. This single factor is then used in place of the overall total in computing productivity. Partial factor models use more than one factor, but fall short of being total factor evaluations.

Surrogate measures, which link productivity to more easily observed characteristics, such as utilization of equipment capacity, have been proposed as an alternative to the preceding actual product measures (Stewart, 1978:34, Armentrout, 1986:142). Process measures are another alternative, where the method used to achieve the end product is evaluated. The measurement formula devised must correspond to the effectiveness of the actual product, be it design or facility, not just activity related to it (McGeorge, 1988:352). The points in the processes where evaluations are to be made is likewise important. Convenient points of assessment are the interfaces between separate subprocesses which make up the whole (Kacker, 1988:41). In some cases, surrogate or process measures are much more easily attained than the product measures, due to the previously mentioned difficulties in quantifying product attributes.

Absolute measurement systems evaluate performance compared to some externally defined standard. The Engineered Performance Standards (EPS) used in evaluating craftsmen's work are of this type. Such absolute scales are difficult to develop for engineering design. Another measure of interest would be comparing how well the promises and commitments to clients were kept (Armentrout, 1986:143).

Table 3. Measurement

<u>Levels of Measures</u>
Total Factor
Partial Factor
Single Factor
<u>Types of Measures</u>
Product
Process
Surrogate
<u>Classes of Measures</u>
Relative
Absolute

Comparative measures have also been proposed as a solution to the problem of establishing absolute scales for evaluating the productivity and quality of engineering organizations. Evaluation might be made on the basis of volume of output supported against the most competitive engineering firms (Takei, 1981a:13) and against government engineering departments. Alternatively, performance trends of the subject organization might be tracked over time to assess progress and improvement (Stewart and Calloway, 1982:115).

<u>Role of Measurement</u>. Measurement is a fundamental tool to be used in the performance management framework. A measurement and feedback system must be created which allows the processes of interest to be monitored and improved (Dingus and Hrivnak, 1988:30). A system to measure

performance is essential in order to understand the causes of variation in work processes which lead to job breakdowns (Hacquebord and Scholtes, 1988a:29). Measurement of productivity is a necessary ingredient in any effort to improve productivity (White and Austin, 1989:371). Accurate measurement of performance is useful for other purposes as well. Once improvement actions have been implemented, measuring the impact of those actions can permit errors in the improvement actions to be fixed before proceeding (Edosomwan, 1987:67). These modifications generated from the feedback from improvement efforts can result in even greater performance improvements. The measurement of improved performance can be a record to show to management to convince them of the value of the performance management effort (Gilly and others, 1987:436). If performance management is competing with other opportunities for scarce resources, this evidence of success can be important in ensuring the continuance of the effort.

Table 4. Roles of Measurement

1) Evaluate Processes
2) Improvement Feedback
3) Sell Management

<u>Degree of Employee Involvement</u>

Performance management stresses the employees' involvement in management. Individuals from all levels of the organization, including the line workers, share in decision making. This employee involvement can be used in first identifying the processes to be improved (Hacquebord and Scholtes, 1988b:46). The employees affected can then be included in brainstorming possible solutions to problems and strategies for improvement (Department, 1989a:11). Group interaction can also be used effectively in establishing the measures to be used in evaluating quality and productivity (Stewart and Calloway, 1982:114).

Table 5. Employee Involvement Possibilities

1) Identify processes for improvement
2) Brainstorm problems and solutions
3) Establish measures

Two formats for employee participation are the work group and the quality circle. Quality circles are comprised of workers from a single work setting within the organization, and often include their immediate supervisors (Steel and Lloyd, 1988:3). Work groups are temporary teams assembled from members of the several work settings which comprise a process within the organization. A particular team will continue to meet until the improvement desired to a process has been accomplished, and will then be dissolved (Department, 1989a:15).

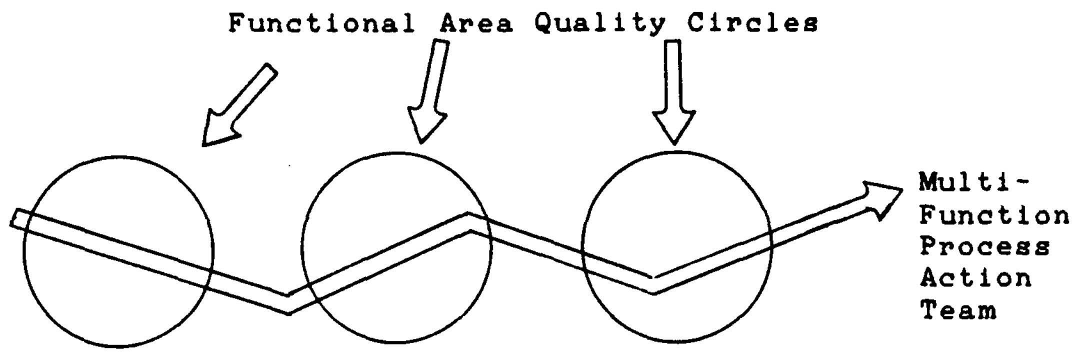


Figure 8. Two Types of Teams

Extent and Nature of Training

Extent. Training of the employees and managers involved in TQM is important. One approach to assure training does not miss anyone is to train everyone at the outset (HQ AFLC, 1989a:10). A major risk of doing this is that by the time the last people are being trained the first ones will be losing their enthusiasm for the program (Roth, 1989:28). A better approach is to get started into the quality transformation and then provide the training required at the time needed (Hacquebord and Scholtes, 1988b:48).

Nature. A cultural transformation needs to take place in an organization for a performance management framework to be effective. Training is an important vehicle for accomplishing this change in culture. The new attitude needed is one where every member of the workplace thinks improvement, and brings a pride and enthusiastic approach to their improvement efforts (Ryan and Sebastanelli, 1987: 331-2). A problem with many training programs is that not enough attention is paid to this cultural change; too much emphasis is placed on teaching the tools of performance management (Warmington, 1988:36). The team leader and facilitator should be the only ones to receive training in the use of these technical tools at the outset; the team members can pick up what they need in the actual on-the-job problem solving (Gilly and others, 1987:429). The tools of particular use in performance management are measurement, control, planning and cause/effect improvement techniques (Edosomwan, 1987:67).

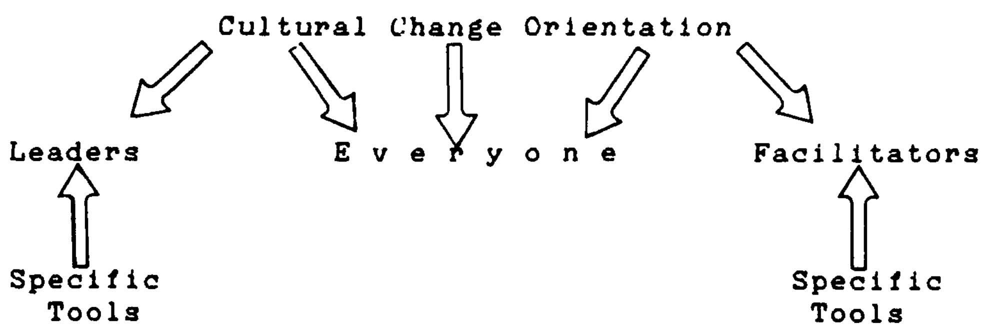
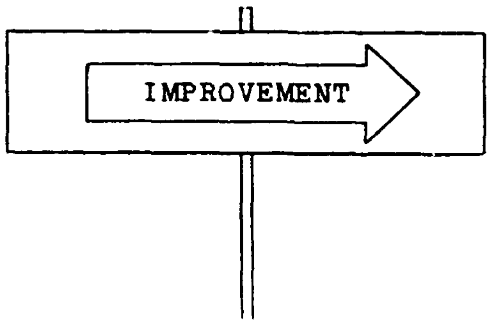


Figure 9. Two Different Training Objectives

Management Commitment

The success of the performance management effort lives or dies on the support and direction provided by management. The improvement program must begin with management commitment and end with management rewarding the participants (Edosomwan, 1987:67-8). Management cannot delegate responsibility for performance management to a staff group or quality coordinator and then forget about it; this communicates that it was not important to begin with (Warmington, 1988:26). Continued management commitment is



One of management's important roles is to direct the improvement effort. The other is to support it.

Figure 10. Roles of Management

needed. When the initial momentum has worn off, only management can jump in to keep the hope alive (HQ AFLC, 1989b:7). The challenge to management is to spur the organization on to improvement, and to provide creative ways to get there (Dingus and Hrivnak, 1988:29). Management's input is critical in deciding which aspects of the workplace are most important in directing the improvement program (Stewart, 1978:37). The potential for the greatest improvements is at the early conception and development phases of the work process; these are management's domain, and need their attention to achieve all the improvements possible (McGeorge, 1988:358).

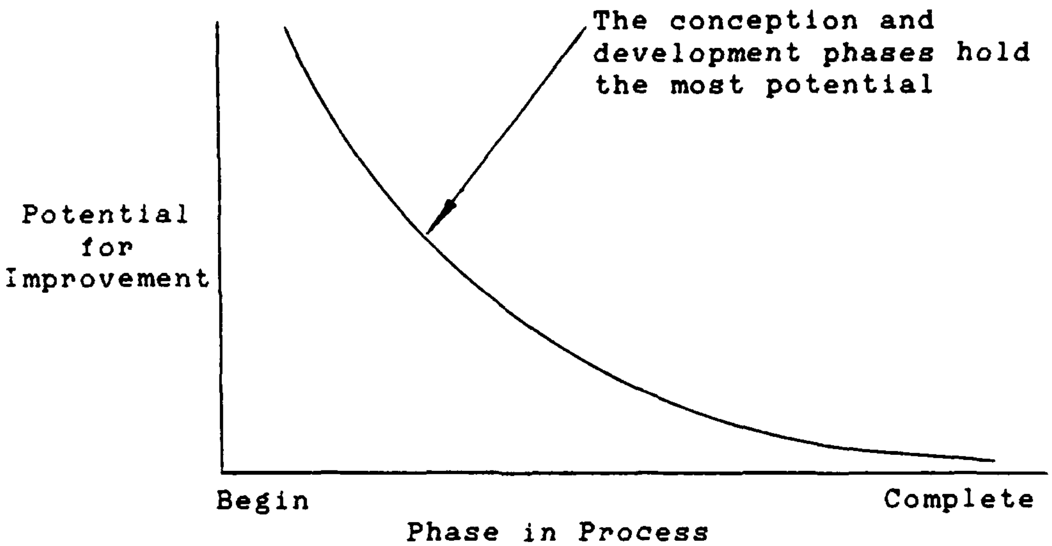


Figure 11. Process Improvement Potential

When the performance improvement team has developed its proposed solutions, attention must be returned to management. A management presentation is an ideal way to make this transition. The team prepares their solutions in the form of a fifteen to twenty minute presentation. Top management and the department heads affected are invited. The presentation should include a specific request for action by management. This high visibility presentation serves not only to inform management of the results of the team's effort, but it also allows the team members to conclude their activities on an exciting note. (Todd, 1990)

Process Improvement

Identification of Process for Improvement. Before the processes which make up the way an organization does business can be improved, those processes need to be made visible and mapped out (Kacker, 1988:41). Asking workers whom within the organization they depend on can provide clues to internal provider relationships. Discovering whom they provide service to can help to uncover the customers in these processes. Determining these providers and customers helps establish the interfaces between subprocesses (Hacquebord and Scholtes, 1988a:29). In an engineering environment the overall process is made up of three distinct phases: planning, analyzing, and coordination (Stewart and Calloway, 1982,110).

Figure 12. Phases of the Engineering Process

Scope of Process. Improvement of engineering design will be most effective when the improvement efforts are aimed at the entire design and construction process, from conception to delivery of the completed project to the customer. Quality, an important component in design, is dependent on the quality with which each individual step in the design process is completed, from initial surveys and information gathering through design to production and testing (Takei, 1986:92). Much attention has been given to improving the technical design and drafting steps in the process, through innovations such as standardization of details and CAD. However, vast improvements at minimal costs can best be made in the early concept stages of project design (McGeorge, 1988:353,357). Having started with design, improvement efforts must continue, through construction, until the facility is delivered to the user to be effective (Gilly and others, 1987:428).

Strategy for Improvement. Once the process is identified a strategy for improvement needs to be developed.

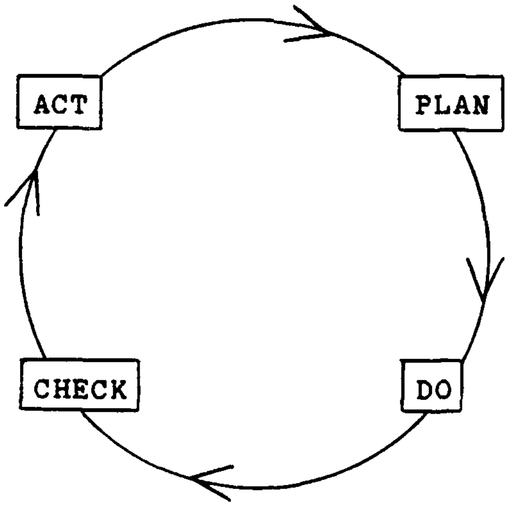


Figure 13. The Deming Wheel

An effective model to use for this strategy is the Deming Wheel, which consists of planning ways to improve, doing what is needed to get started, checking the effectiveness of the activity, then acting to complete the planned improvement, and starting all over again with planning a new improvement (Hacquebord and Scholtes, 1988b:46). An alternate to the Deming Wheel is the productivity cycle, defined as measuring current productivity, evaluating the results, planning how to improve the level of productivity, then implementing the improvements, and beginning again with measuring productivity (Sumanth and Yavuz, 1983:261).

Implementation

Facilitators. The facilitator is an important part of the performance management team. The job of the facilitator is to observe the participation of the members of the team, and to direct them in the problem solving process. Toward this end, the person selected to facilitate the team should attend a three or four day training course to learn what to look for and the tools to suggest (Gilly and others, 1987:429). The facilitator can have a profound impact on the team's effectiveness; "...an effective facilitator can unlock the energy and intelligence of the group to solve problems" (Fishman, 1989:22). The person facilitating the team may not be the boss of anyone on the team, or participation will suffer (Roth, 1989:30).

The duties of the facilitator start with planning each meeting. Drafting and posting an agenda to outline the goals and schedule of the meeting can help keep the group time focused. This motivates the team members to apply themselves to the subject and goals, by being aware of what needs to be accomplished. Further duties of the facilitator are to get the other group members involved in the work. Tasks need to be delegated to others as much as possible. These tasks might include keeping minutes, recording important thoughts on an easel pad or overhead for the group to refer to, or developing charts and graphs to illustrate information. (Todd, 1990)

Figure 14. The Facilitator is the Key

<u>Methodology</u>. When TQM is first implemented in an organization, an awkward start is to be expected. Management needs to get the ball rolling and establish some momentum in order to get through this start-up (Hacquebord and Scholtes, 1988a:28,31-32). One suggestion is to try a high visibility and easily understood process for the first improvements (Townsend and Gebhardt, 1989:20). Another possibility is distributing articles trumpeting the

successes of performance management prior to kicking-off the effort itself (Ryan and Sebastanelli, 1987:328).

Planning for the improvement effort is essential before diving in. One of the main reasons performance management fails is due to a lack of strategic planning for the change (Vogt and Hunt, 1988:96). Caution is in order to make sure a framework is well thought out before starting any kind of team improvement efforts (Roth, 1989:29). Use of a steering group is recommended to list the key processes in the workplace and assign facilitators and improvement teams to tackle them (Department, 1989a:35). Part of this initial planning is to identify who the informal leaders in the organization are, and develop a strategy to use their help in implementing the performance management framework (Hacquebord and Scholtes, 1988a:31).

Small problems are a good place to start on a brand new performance management framework (Gilly and others, 1987:435). This way some early small successes can help bolster enthusiasm for later larger projects. Follow a process of identifying a theme for improvement, determining the important factors affecting that theme, and then seeking to measure and improve those factors. The theme may be reducing customer complaints, shortening turn-around time, or similar goals (Takei, 1986:93). The factors must be well understood, and the problems correctly diagnosed, before applying solutions, or lasting improvements may be missed

(Warmington, 1988:40). Management must act on the recommended actions for implementation from the team, or the team will give up due to the perceived futility of their work (Vogt and Hunt, 1988:96).

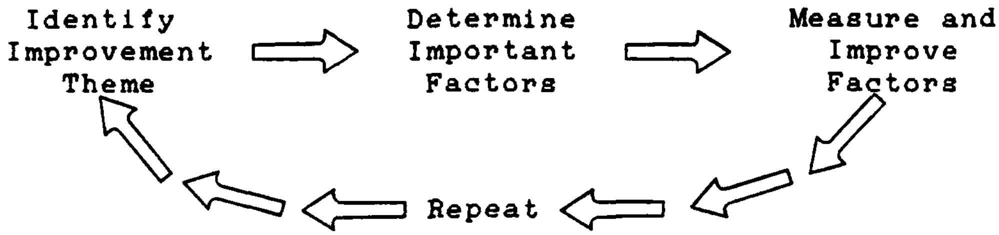


Figure 15. Improvement Theme Methodology

Summary

TQM is a management philosophy which has been used by both manufacturing and service organizations to improve the way they do business. The United States Department of Defense has mandated that all military organizations adopt TQM techniques in order to cut costs, improve productivity and job satisfaction, and provide better customer satisfaction. Air Force Engineering Branches are among those affected. Because engineering generally deals with ideas instead of tangible products, the way a performance management framework will be implemented and its success measured needs to be carefully considered.

The literature reviewed in this paper summarized the current thought on how to accomplish this. Managers need to determine whether to stress quality, productivity, customer satisfaction, or some aggregate of these. The processes for which they are responsible must be identified and strategies prepared to improve them. It is important to establish meaningful measures for productivity, directly or through a surrogate measure. Managers must determine where to make these measurements and how to judge the results obtained. A plan for the degree and nature of involvement for employees needs to be decided upon, as well as how and when to train those employees. Managers must also be sensitive to creating the initial enthusiasm required to get their programs off the ground.

III. Research Method

Overview

A case analysis of the 2750 Civil Engineering Squadron Engineering Branch located at Wright-Patterson Air Force Base, Ohio, was the primary method used to address the specific problem and investigative questions previously described. One reason this Engineering Branch was chosen was because of its proximity to the researcher, providing for ease of making the required observations for a case study. A second reason is because its Major Command, Air Force Logistics Command (AFLC), has been emphasizing TQM, so that the Branch was already interested in performance management, though no steps had been taken to implement any framework for improvement prior to this research.

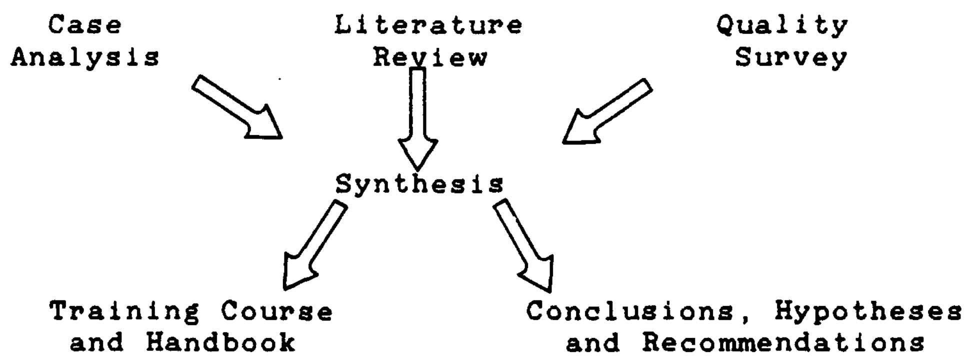


Figure 16. Research Method

In addition, a survey instrument called the Quality Questionnaire was used to determine any shift in attitude toward quality that accompanied the implementation of performance management. Statistical tests were utilized to determine if any significant change occurred.

The insights gathered from the careful observations of the case analysis were combined with knowledge obtained from a thorough review of the literature to develop a training course and handbook for engineering managers interested in implementing a framework for performance management. Hypotheses and recommendations regarding the implementation of performance management in Engineering and Contract Planning Branches of Air Force Civil Engineering Squadrons were generated.

Literature Review

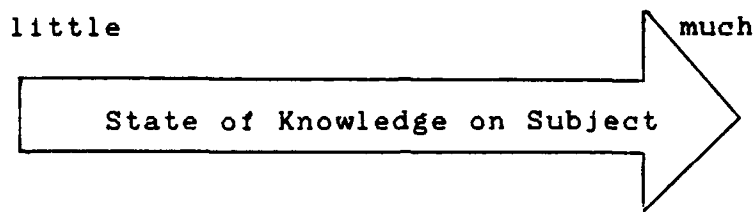
A comprehensive review of the literature published on a subject is a crucial element to any research. It is in the literature that researchers find the current state of knowledge on a topic and thereby can assure that they are not going over the same ground which has already been covered.

Concurrent with the case analysis described below, a representative review of published literature on the subject of performance management implementation was accomplished. Particular emphasis was placed on recent papers and articles in professional journals. The search for such articles began with a search of defense oriented literature and a search of industry and trade journals. Both searches were assisted by the Air Force Institute of Technology library staff using on-line computer aids at the researcher's request. Beginning from the references identified by these searches, and continuing with references cited in the bibliographies of these articles, the literature was reviewed. Notes of important information were taken and organized by topic for use in comparing to insights from the case analysis. (Selltiz and others, 1964:53)

Case Analysis

Justification for Case Analysis Design. The state of knowledge regarding performance management implementation is still in its infancy. Very little has been published focusing on performance management in American government or the engineering environment. Therefore, an exploratory qualitative research design is desirable, to increase this state of knowledge. Exploratory research should be seen as the important first step in an ongoing research process. This process culminates in the quantitative research analysis of hypotheses and/or descriptive and causal studies. However, proceeding to such quantitative research prematurely, before qualitative research has allowed the formulation of appropriate hypotheses and research questions, can decrease the effectiveness of such quantitative research. (Selltiz and others, 1964:52)

Four options are most appropriate for such exploratory research: historical, case analysis, delphi technique, and meta-analysis. The meta-analysis was rejected because of the scarcity of published literature applicable to the



<u>Qualitative Methods</u>	<u>Quantitative Methods</u>
Historical Analysis	Hypothesis Testing
Case Analysis	Causal Analysis
Delphi Technique	Descriptive Studies

Figure 17. Qualitative Versus Quantitative Research

research problem. The historical method was rejected because most of the track record on performance management is from Japan. The extreme cultural differences between Japan and America would make lessons learned from the first difficult to apply to the second. The delphi technique would be a powerful tool to use in this situation when more experience has been gained by people in America using performance management. At the present time, however, use of an in-depth case analysis to observe and report on performance management implementation first hand was selected.

The case analysis is useful to discover knowledge on a subject with the end of establishing a definite hypothesis or research problem for further study (Selltiz and others, 1964:50). A strength of the case analysis is its ability to provide an intensive examination of a single unit. From this examination not only the broad picture but the fine details can be recorded and analyzed. Another strength is that the end result is not just a snapshot in time of the condition of the subject. A record of the steps taken, problems encountered, and corrections made is preserved.

A principal weakness of the case analysis is that it is not easily replicated. The results obtained are in some ways peculiar to the subject of the study; ability to generalize the results are reduced. Another weakness is the potential for the researchers/observers to include their personal bias in the reporting. They must be ever alert to remain objective (Selltiz and others, 1964:60).

Table 6. Case Analysis Characteristics

<u>Strengths of Case Analysis</u>

1) Create knowledge on subject
2) Provide broad understanding of subject
3) Preserve record of case development

<u>Weaknesses of Case Analysis</u>

1) Hard to replicate results
2) Generalization of conclusions limited
3) Subject to bias of researcher

Description of Case Analysis. The Chief of the Engineering and Contract Planning Branch was contacted in August 1989. Arrangements were made to establish a team to evaluate and improve the process of design review. This process was chosen by the Chief as needing improvement. Design review is a process whereby the affected organizations on the Air Force installation review the plans and specifications for proposed construction work.

Five individuals were assigned by the Chief to participate on the team. Each member was a representative of a particular function within the Engineering Branch contributing to the process. The individuals chosen were not perceived to have any distinctive aptitude for the task over other members within the same function.

The team met once a week for one hour from November 1989 through summer 1990. The team followed the scientific method for problem solving. They identified the steps in the process, developed a list of problems they were aware of, proposed solutions to these problems, and formulated programs to implement these solutions.

The researcher attended these meetings as a facilitator and observer. The team was assisted in following the scientific method. A member of the Industrial Engineering Branch of the Civil Engineering Squadron, experienced in facilitating such a team endeavor, assisted. Important information was noted as it surfaced about implementation of the framework for performance management. The ingredients essential to successful case analysis research were considered: 1)open-minded and careful scrutiny; 2)accurate synthesis of the data (Selltiz and others, 1964:60). To this end, notes and minutes of the meeting were kept and organized into topics. These topics were compared to those developed from the review of the literature described above. In this way consistent trends were established from both published and observed characteristics.

Quasi-Experiment

Justification for Quasi-Experiment. An important consideration in implementing performance management is the cultural change, or adjustment in attitude, which first must occur for the effort to be successful (Warmington, 1988:36). Observing the change in individuals' attitude toward quality issues such as leadership, planning, and customer satisfaction associated with the case analysis may reveal insight into this cultural change.

A non-equivalent control group design was chosen to augment the case analysis. Figure 3.18 shows the form of the quasi-experiment. The goal was to measure whether attitudes changed toward quality among those participating on the quality improvement team. Because the treatment group was selected in a non-random fashion, a true experiment was impossible. The researcher had the ability to test the treatment group before and after the treatment, and a control group at the same times, so the quasi-experimental design was chosen as the most powerful available. (Campbell and Stanley, 1963:34)

$$\begin{array}{ccc} O_1 & X & O_2 \\ \hline O_3 & & O_4 \end{array}$$

where: X is the treatment

O_1 is the treatment group pretest

O_2 is the treatment group post-test

O_3 is the control group pretest

O_4 is the control group post-test

Figure 18. Experimental Design

Description of Quasi-Experiment. A survey instrument called the Quality Questionnaire was used to measure attitudes (Hayman and Schneider, 1989). The instrument consists of fifty-four statements which allow a response on a seven point Likert scale ranging from strongly disagree to strongly agree. Because the presentation of the scale includes the integers one through seven, the data obtained are assumed to be of interval level. The survey yields results that allow the use of T-tests and other parametric statistical tests (Hayman and Schneider, 1989:23). The population characteristics of the sample data are assumed to be normally distributed from a population of infinite size.

```
          1    2    3    4    5    6    7
          |____|____|____|____|____|____|
          |                             |
Strongly Disagree               Strongly Agree
```

Figure 19. The Survey's Likert Scale

The control group was selected to match experience and authority levels with the treatment group as closely as possible. Due to difficulty in selecting members in similar positions for the control group, the pretest was administered to the control group two months after the treatment group was tested. The affect of this delay will be discussed below. The pretest results from each group were compared to verify that in fact no significant difference in scores on the questionnaire existed. The quasi-experimental design used is most effective when the control and treatment groups are equal (Campbell and Stanley, 1963:48). This was done using a two sample t-test with the null hypothesis being no difference and the alternate hypothesis being any difference positive or negative. The results obtained confirm the null hypothesis; the groups are declared to be equal.

The change in scores on each statement were then compared between the treatment and control groups using a two-sample paired t-test. The null hypothesis was that no difference in change in scores existed between the groups. The alternate hypothesis was that the treatment group had a significantly different change in scores than the control group.

Validity of the Quasi-Experiment. The non-equivalent control group design controls the following obstacles to internal validity: history, maturation, testing, and instrumentation. The control of maturation and instrumentation was compromised to some unknown degree due to the delayed administration of the pretest to the control group noted earlier. The researcher is unaware of any significant events during the two month period the test was delayed, so maturation may not have been significantly affected. Both the treatment and control groups had a period of from five to seven months between their pretest and post-test, so the difference in instrumentation may not be important. However, this weakness in the administration of the experimental design is noted, with its corresponding potential affect on the experimental results.

The obstacle of regression is controlled if the treatment and control groups are equal. A test of equivalency was performed. The obstacle of selection-maturation interaction is reduced when the members of the groups are assigned, rather than volunteers. The obstacle of mortality was controlled by assuring that no members of the groups dropped out between the pretest and post-test. (Campbell and Stanley, 1963:48,50)

Table 7. Validity of Quasi-Experiment

The non-equivalent control group experimental design controls the following obstacles to internal validity.

1) History
2) Maturation
3) Testing
4) Instrumentation
5) Regression
6) Selection-Maturation
7) Mortality

The quasi-experiment is intended to augment the case analysis. Its external validity, or ability to be generalized beyond the tested groups, is not a critical issue. The case analysis itself will be the controlling factor on the external validity of the results.

Training Course Development

From the information gathered in the literature review and the case analysis, a training course was developed to implement a Performance Management Framework in the Engineering Branch of Air Force Civil Engineering at the base level. This training course is a synthesis of the information drawn from the case analysis with the theoretical information collected from the literature review. The method used to develop this training course consisted of the following nine steps.

1. Identify overall goal and target audience.
2. Identify subject areas that contribute to goal.
3. Identify educational objectives within each subject.
4. Structure subjects into integrated program. Set time allotment for each subject.
5. Select educational tools/approach to communicate educational objectives for each subject.
6. Design techniques for communicating objectives.
7. Prepare lesson plans for each technique.
8. Create student handbook for use during training.
9. Create leaders guide book.

Following the procedure outlined above, a Plan of Instruction, Student's Handbook and Leader's Guide were created for a three day training course. The course is specifically tailored to the engineering environment, considering the unique needs and opportunities observed in the case analysis and the literature review. The course is to be presented at the squadron location to the engineers, supervisors, and other individuals involved in the preparation of contract projects in the Engineering Branch. This training course is further described in Chapter V.

Summary

A case analysis, supplemented by a quasi-experiment and a literature review, were chosen to answer the investigative questions. The case analysis provides an intensive examination of a particular subject, and therefore adds to the knowledge of the subject. The information gained from the case analysis was compared to that gathered in the literature review. Comprehensive statements of trends and characteristics observed were then made, along with appropriate hypotheses and recommendations for further research. A training course and handbook to guide implementation of performance management in other engineering organizations were developed. The course is unique in that it focuses on the particular needs of the Air Force engineering environment. This training course and handbook, along with the above mentioned conclusions, recommendations, and hypotheses, are presented in Chapter V.

IV. Results and Discussion

Overview

A performance management team was formed in the Engineering Branch to evaluate and improve the design review process. The team worked through a problem solving routine for the Corps of Engineers design review. This routine actually improved the process. From watching this team in action, the researcher observed principles of performance management in an Engineering Branch environment. A rigorous approach was used to record, sort, and analyze these observations.

The Quality Questionnaire survey was administered to the performance management team and a control group. The change in attitude toward quality was compared between the two groups. Recommendations will be made and conclusions drawn from these results in Chapter V.

Case Analysis

Description of Case. The Chief of the Engineering Branch of the 2750 Civil Engineering Squadron at Wright-Patterson Air Force Base, Ohio was approached during August 1989. The possibility of implementing Total Quality Management (TQM) in the branch was discussed. A team was proposed to evaluate the performance of a work process in the Engineering Branch.

The branch Chief was skeptical of the usefulness of TQM in an engineering environment. Previous efforts to use TQM in the Engineering Branch had been resisted for this reason, though other branches in the squadron had used TQM Process Action Teams (PATs) and Quality Circles. However, the Chief agreed to support the formation of a team. The design review process was suggested as a focus. The branch had been having difficulty making consistent and thorough comments on projects. The process was in need of an overhaul. The Chief felt that this would be an ideal opportunity to give TQM a try. A plan was made to begin the effort after the start of the fiscal year, 01 October 1989.

The Engineering Branch Chief hand-picked a PAT to include one member each from programming, design, design support, and construction management. The supervisor of all these members was included as well. Each member was chosen

Table 8. The Five Team Members

1. Programming Section Representative
2. Design Section Representative
3. Design Support Representative
4. Construction Management Representative
5. Engineering Branch Supervisor

only on the basis of their familiarity with the function of their particular sections in the design review process. None were perceived to have any predisposition toward quality improvement over others in the same sections.

The researcher coordinated the preparation for the PAT with a member of the Industrial Engineering Branch (DEI). This individual had experience with PATs and Quality Circles in other branches of the squadron. A plan was developed to implement the PAT in the Engineering Branch. The researcher would function as the facilitator for the team, leading the team through the problem solving routine. The DEI member would provide initial training and attend the meetings as an observer and resource person as needed.

The initial team meeting was held 02 Nov 89. Training was provided to introduce the problem solving routine the team would follow. This routine is shown in Figure 20.

Write Flow Chart for Process

⇩

Identify Problem Causes

⇩

Develop Solutions

⇩

Implement and Evaluate Solutions

Figure 20. The Problem Solving Routine

The problem solving routine followed was based on the scientific method. Some group problem solving techniques the team might find useful were introduced as well. These included brainstorming, cause and effect analysis, and pareto analysis. Details of how to use these tools were withheld until the team might actually have need for them.

After the training, and throughout the following meetings, the team followed the problem solving routine to evaluate and improve the design review processes. Four separate processes of design review were identified, distinguished by the different design agents acting.

Table 9. The Design Review Processes

1. Corps of Engineers
2. Operations and Maintenance Architect/Engineer
3. Operations and Maintenance In-House
4. Aeronautical Systems Division

The process flow charts for each of these four processes were the first thing the team accomplished. These flow charts are displayed in Appendix E.

Table 10. Corps of Engineers Review Process Steps

1. Designer Selected
2. Submittal Arrives
3. Distribute for Review
4. Collect and Filter Comments
5. Send to Headquarters
6. Repeat from Step 2 until 90%
7. End

The team selected the Corps of Engineers process as the first one to study. They decided to follow the rest of the steps in the problem solving routine on this process before beginning on the next process. This was accomplished in one-hour weekly meetings, and was completed 01 Mar 90. A summary of each of these meetings is included in Appendix D. An integrated list of the problems identified, solutions proposed, and actions recommended for implementation for each step of the Corps of Engineers design review process is given in Appendix F.

The team continued to meet after 01 Mar 90. The Operations and Maintenance design review process was selected for attention next. The researcher continued to meet with the team as facilitator through 29 May 90. The study of the second process was not completed by the team in time to be included in this research. The team's intention was to continue meeting until all four processes were completed and improvements implemented and evaluated.

Results of Case. As a consequence of their evaluation of the Corps of Engineers design review process, the team recommended actions which were implemented to improve the process. Measures were established to track the effect of the implementations and determine if in fact improvements were realized. In the short amount of time available after the actions were taken, no significant data from these measures were obtained to document the effectiveness of the improvements. The actions taken as solutions to specific problems can be reported, however, and statements made of how they seemed to be working. These actions are listed in Table 11.

Table 11. Solutions Resulting from Case

Provide Base Input to Selection Committee
Create a Plan Review Room
Combine and Update Review Distribution Lists
Develop a User Review Checklist
Make Sure CE Shops are Included in Review
Develop Procedure for Environmental Review

One problem identified was that the Architect/Engineer design firms selected by the Corps of Engineers were consistently giving a poor response to projects at Wright-Patterson Air Force Base. This problem was traced to the selection of the designer in the process. The cause was determined to be that no base input was used by the Corps in selecting designers. Consequently, the design firms were often located in Louisville, KY, where the Corps office was. Some firms whose performance was consistently bad seemed to keep being selected, when the base would have ruled them out of contention long ago. The solution proposed was to provide feedback from the base about the firms in contention for new projects, or better yet to get a base representative to the committee meeting in which the designers were selected. The team discovered that the Corps had an open invitation for an Air Force representative to sit on the committee as a voting member, but no one had been attending!

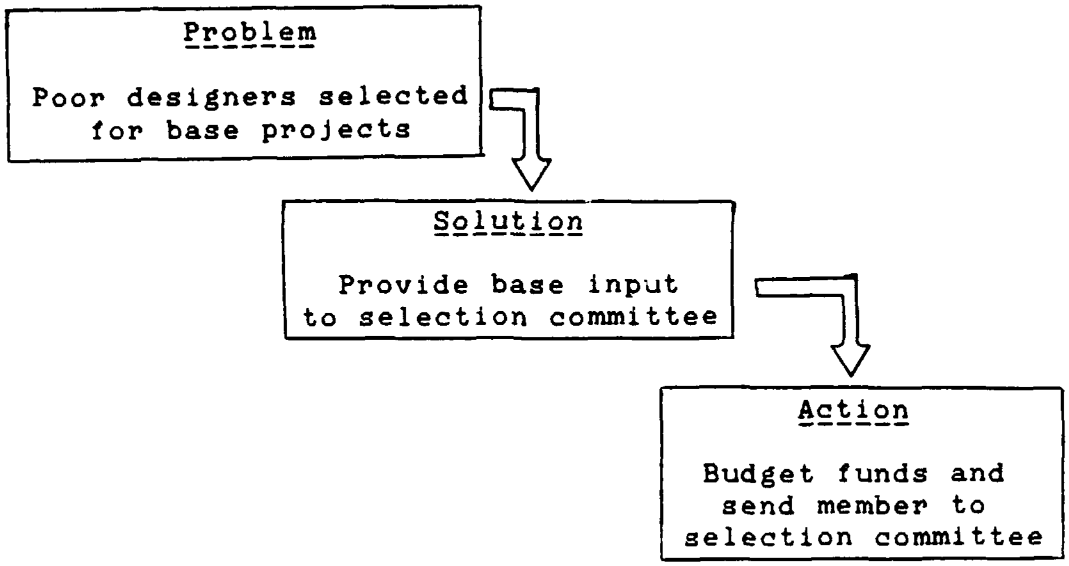


Figure 21. Selection Committee Solution

The solution was for the Engineering Branch to budget funds to send a representative to each selection committee meeting. Better communication with the Corps was established, too, in order to be aware of when a meeting is scheduled. The team is confident that this input to the selection process will improve the calibre of designers selected.

Another problem identified was that some of the reviewing agencies on base were not returning comments in time to forward to the Corps. This problem was traced to the Distribute for Review step in the process. The cause was determined to be that the limited number of copies of the submittal available had to be passed around between the various agencies. Those who received the package last did not have enough time to perform a thorough review. The solution was to create a plan room at the Engineering Branch location. The action taken was to set aside an area where plans could be laid out for review, and send a letter to each agency for each submittal to come, review and comment. The response was good. The agencies were sending representatives to review the submittals in the time frame allowed. More and better comments were being received, because the Engineering Branch representatives were right there to answer any questions the reviewers might have. The branch was able to keep a record and keep better control of who was reviewing projects as a result.

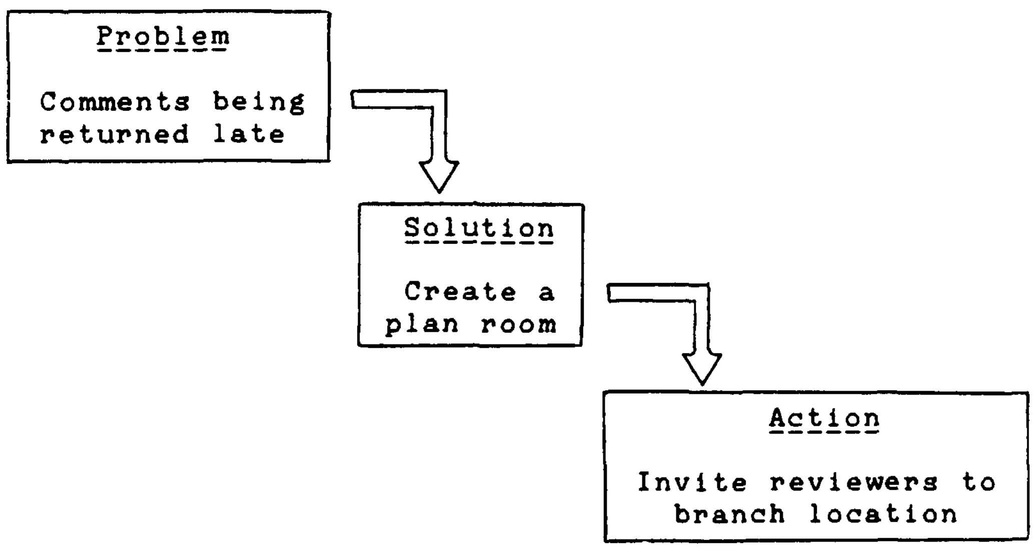


Figure 22. Plan Room Solution

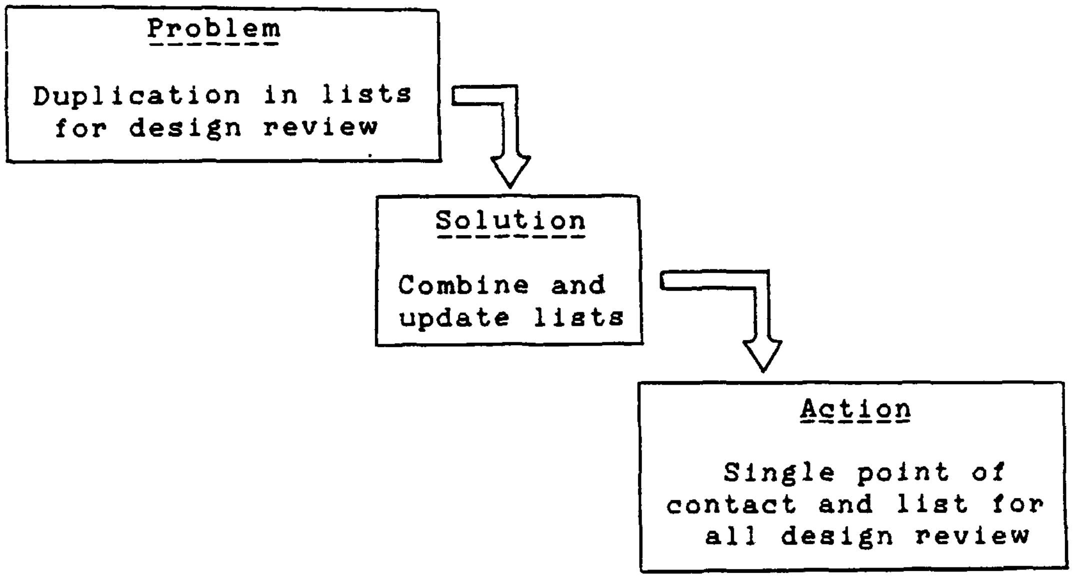


Figure 23. Review Distribution List Solution

Conflicting distribution lists for review was another problem. The two sections responsible for different levels of the design review had different lists of who should review the project. Further, the Chief of Design and Chief of the Engineering Branch were on neither list. This problem fell under the Distribute for Review step of the process. The cause was lack of coordination and not updating the lists. The solution was to make one list for everyone's use. The action taken was to make one person in the Design section responsible for all design review. This person would keep the master distribution list and update it at least yearly. All letters to agencies inviting them to review submittals, and their comments, would be handled by this one person. The team is confident that the other agencies will appreciate the single point of contact for the branch, and the elimination of duplicate efforts of review.

Another problem found was poor comments often made by the users. This problem was identified in the Distribute for Review step of the process. The cause was that the users often did not understand the construction drawings in the submittals, and did not know what to look for. The

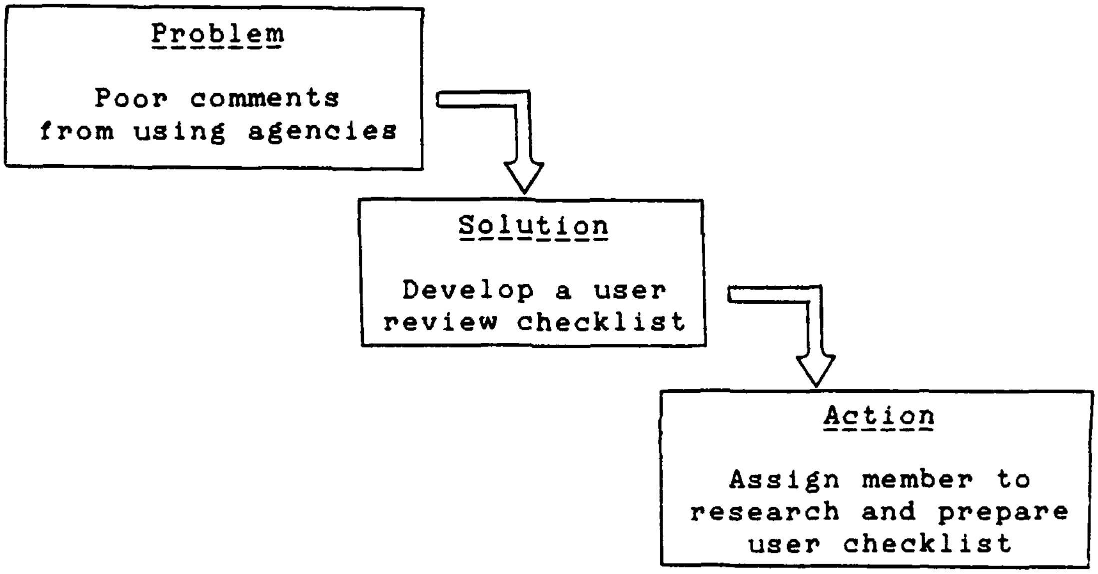


Figure 24. User Checklist Solution

solution proposed was the creation of a checklist to prompt the users with items they should look for in their review. The action taken was to assign a member of the team to find out what kind of checklists city and state governments or other Air Force organizations used, and adapt these as needed to the requirements at Wright-Patterson. The team is hopeful that given this guidance, users will be better equipped to review the submittals intelligently and make comments about the project scope and special requirements that are needed to satisfy these users.

The next problem was identified in the Collect, Compile, and Filter step of the process. Comments from the Operations and Maintenance Branch (DEM), responsible for maintenance of completed construction, were often incomplete. Its cause was a breakdown within DEM in getting all the various disciplines of maintenance to review the

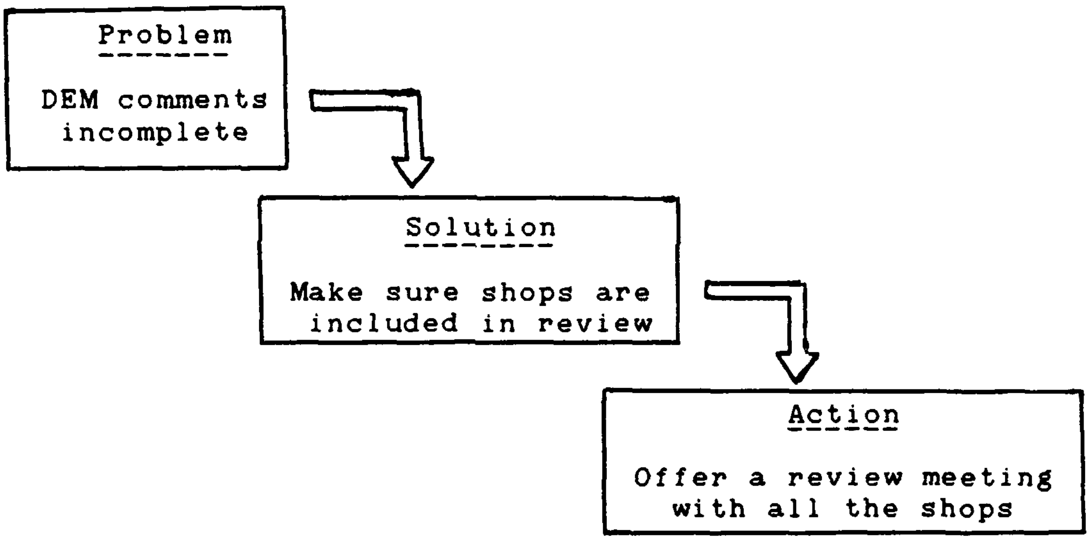


Figure 25. Shops' Design Review Solution

project. Just one shop, for example the plumbing shop, would review the submittal, but comments from the electrical, HVAC, and carpentry shops would be missing. The solution was to make sure the projects were being coordinated with all the shops. The action taken was to suggest to DEM that a review meeting be held for each submittal. A representative from each shop would gather at one location with the project engineer and all comments would be discussed. The team anticipates that this offer will result in better communication with DEM and more thorough comments.

A growing problem was found to be coordination with the Environmental Management (EM) office. With the increasing emphasis on environmental concerns, many of EM's functions were new and unknown to the Engineering Branch. Their comments were often vague and general in nature. This problem was traced to the Collect, Compile, and Filter step

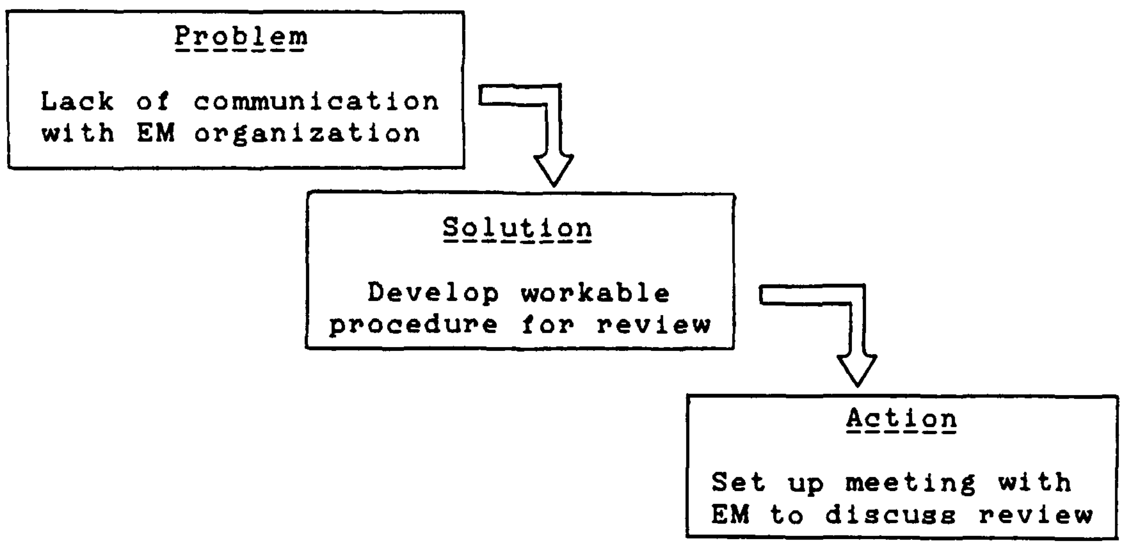


Figure 26. Environmental Management Review Solution

of the process. The solution was to open communication with EM and gain an understanding of their organization and purpose. The action implemented was setting up a session between the EM Branch chiefs and the Engineering Branch chiefs to get acquainted. Further action would be pursued from there. The team felt that opening this communication was critical, and would result in better cooperation between the organizations.

These actions illustrate the kind of improvements the team was able to develop during their study of the Corps of Engineers design review process. None of these are revolutionary or remarkably creative in and of themselves. What is remarkable is that these were definite actions taken to solve specific problems the branch experienced. In some cases the problems had existed for years. It took the formation of the performance management team and their mandate to evaluate and improve the process to see these problems corrected.

Observations from Case Analysis. The goal of the case observation was to add to the body of knowledge on the subject of performance management in the engineering environment. The results the team achieved were commendable, but were not the goal of this research. The experiences of the team, as it worked through the problem solving routine, were recorded in order to reveal principles of performance management.

Observation Procedure. The procedure followed to withdraw principles from the case analysis was to record and synthesize the observations. Appendix D contains records summarizing each meeting the team held in studying the Corps of Engineers design review process. In addition, each record contains notes made by the researcher of observations

Table 12. Case Analysis Observation Synthesis Procedure

1. Attend and observe meeting
2. Make notes of observations
3. Assign notes to subjects
4. Synthesize principles from subjects

pertaining to performance management. These notes are the researcher's evaluations and judgments of the experiences of the team. After these notes, each entry lists several subjects to which the researcher believed the contents of the notes applied. This is how the observations were grouped into principles of performance management. These principles are discussed under the next heading.

Table 13. Case Observation Subjects

1. Training
2. Implementation
3. Process Technique
4. Goal of Improvement
5. Participation
6. Culture Change
7. Facilitator
8. Management Commitment
9. Management Direction
10. Measurement

Discussion of Observations. The subjects identified in the observations of the case are listed in Table 11. These subjects each appeared in notes from one or more of the meetings summarized in Appendix D. Each subject is discussed briefly below in light of the observations made of the performance management team.

Training needs to be appropriate to the experience level of the people on the team. Adequate training is important. Skimping on training at the start may result in the team getting stuck later on. For example, if the team is not adequately trained in the group technique of brainstorming, one or two members may tend to dominate discussion. This would tend to remove important contributions from other members from the group's attention.

The problem solving routine followed (diagram process flow, identify problems, propose solutions, recommend actions for implementation, establish measures of success) proved to be easy to use. It provided the framework needed to direct the team's attention in evaluating the process. The biggest shortcoming in its use was an inadequate amount of time spent identifying problems. The team needs to be challenged to think more deeply and trace the surface problems they recall to the underlying causes. In addition, the process might be easier to follow if the goal or objective of the team is decided upon at the outset as something more specific than just "improve this process."

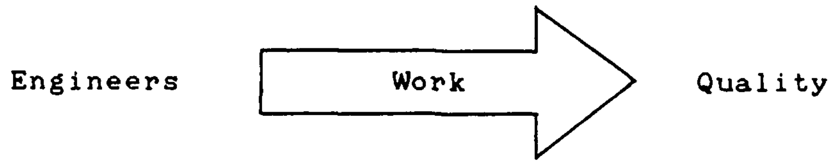
Table 14. Implementation Principles

1.	Follow problem solving routine
2.	Establish goal at outset
3.	Dig for root cause of problems
4.	Invite other affected organizations
5.	Implement a simple action early

Another area that needs emphasis is inviting the other organizations affected by the process interfaces to attend and participate in a meeting. This increases the awareness, understanding, and communication needed to institute effective improvements. Taking immediate action to implement one or some of the simpler improvements is recommended. This permits the team to see the fruit of their labors.

The process technique was instrumental in permitting an understanding of the work the team was studying. Getting the steps of the process mapped out right off the bat contributed to the team's ability to move right through the problem and solution phases. The process steps can be modified later as they are better understood. It is important that the team not set the boundaries of their process too narrowly. The process can be better understood by reaching across the interfaces into the supplier and user steps of the process. "How does it get to us?" and "Where does it go from here?" are two good questions to ask.

The unique characteristics of the engineering environment affect performance management. Engineers are trained problem solvers. They may not need training as detailed as some other functions. Engineers as professionals are typically proud of the quality of their work. Suggestions that their work lacks quality or needs more quality will likely be met with resistance.



Engineers are Committed
to Work for Quality

Figure 27. Engineers and Quality

The goal of improvement may be set by management or determined by the team. In either case, the goal needs to be clearly stated at the outset of the team's effort. The goal must be definite and verifiable. For example, rather than say "Improve the design review process" say "Reduce all change orders by 50%."

Participation is a fundamental concept in team problem solving. Protocol must be followed to assure that all members are given a chance to contribute. In addition, tangents of interest to part of the team but of no interest to others must be controlled, or some members will lose interest. Progress toward the goal must also be maintained, again discouraging tangents. The reigns must not be held too tightly, though. When the team is animated and discussion is active, provide some leeway to see if the discussion will turn into something fruitful and directed to the task before curtailing the interaction to get back on track.

A change in culture is making the adjustment in attitude needed to view the organization's work in terms of its processes and seek to improve those work processes. This culture change can be accomplished "on the job" by getting the team involved in the process oriented problem solving routine. Their perspectives will change as their enthusiasm increases for improving their work. Encourage the team to share with their co-workers what they are doing on the team. Have them invite guests to meetings. Spread the news.

Use of a facilitator to aid the team in following the problem solving routine and keeping on track is encouraged. The facilitator must be careful not to dominate the meetings. In fact, this person might even be almost invisible when the team is working well together. But when the team has a problem and needs help or gets sidetracked, the facilitator can bring an objective voice to bear and assist the team. This person must be ready to refresh the team's memory of where they were and what they were doing after any recess in their regular meetings. He/she must also assure that the materials and room needed for the meetings are in order. The person facilitating the meetings needs to receive training in group dynamics and problem solving techniques prior to stepping into the role. This small investment will be well repaid in improved meetings (Todd, 1990). The facilitator must be ready to be strong and step in as peacemaker when the team starts battling over opposing views.

Table 15. Facilitator Duties and Needs

1. Be invisible (except when needed)
2. Be ready to help
3. Prepare for team meetings
4. Receive training in team dynamics and problem solving
5. Keep the peace

Management must be committed to the efforts of the performance management team. However, management must not crowd the team. Their interest in how things are progressing needs to be satisfied by reports from the team leader or facilitator. The temptation to crash in on a meeting must be avoided, for their presence will curtail team participation. The first line supervisor of the members of the team is an exception. This person may be very beneficial to the team. Implementation actions and delegation are more easily accomplished when such a person is a team member. Management needs to make arrangements for whatever resources the team requires, and to invite representatives from other organizations interfacing with the team's process to attend meetings if needed.

Management has two important selection roles to perform for the performance management effort. The process for the team to focus on must be chosen. Care must be taken not to overload the team on their first attempt. Pick a simple process as a team's pilot project. Let them cut their teeth on it. More detailed processes can follow. The members of the team must be carefully selected. They must know their jobs well and be able to bring that knowledge to the group.

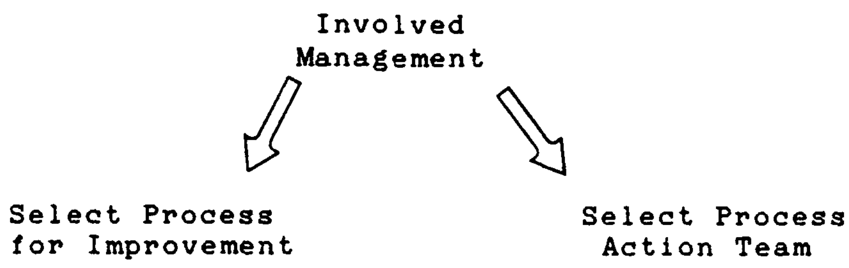


Figure 28. Management Selection of Process and Team

A first line supervisor can be a useful member, bringing lots of related information. The members do not all have to be peers. Further management direction is needed if there is some environmental or organizational change which affects or alters the process the team is working on. The team must be kept up to date on any new information which may affect their effort.

Measurement of success of the actions implemented is a step that must not be overlooked. It is this measurement which will provide the clearest indication of the value of the improvements made. Management will be interested ultimately in seeing a report of each problem identified, solution proposed, action taken, and measured results of that action. The achievements of the team need to be organized in this manner.

Table 16. Contents of Record of Achievements

1. The problem identified
2. The cause of the problem
3. The solution proposed
4. The action taken
5. The measured results

Quality Survey

Results. All five of the members of the treatment group returned both the pretest and the post-test survey. Only four of the five members of the control group returned both. This affects the experiment by reducing the already small sample size, which will increase the magnitude of difference which will be found significant. In addition, some members of the control group left responses blank. This has the same effect for individual questions. The data collected from these surveys is presented in Appendix G. The Quality Questionnaire survey is divided into six major categories, with questions in each to measure attitudes specific to that category. The responses shown in Appendices H through M are divided into these six categories, which are listed in Table 17.

Table 17. Quality Questionnaire Categories

I.	Leadership
II.	Strategic Quality Planning
III.	Human Resource Management
IV.	Quality Assurance of Products and Services
V.	Quality Results
VI.	Customer Satisfaction

The statistical tests of the data are contained in Appendix M. The assumptions, hypotheses tested, and procedure used for testing are recorded. Four separate tests were performed. These are listed in Table 18 The

Table 18. Statistical Tests Performed

1. Comparison of Groups' PreTest Results
2. Comparison of Groups' PreTest Variance
3. Comparison of Groups' Change Results
4. Comparison of Groups' Change Variance

first test was for the equivalence of the control and treatment groups at the time of the pretest. This equivalence is a condition of declaring the obstacle of regression controlled in the experiment. The results of this test are contained in Appendix I. For each question, the average response of the treatment group was compared to the average response of the control group. For all but one question, the two samples were found to be the same, at the precision level alpha of 0.05. The treatment and control group were then declared equal for the purposes of this experiment, and the obstacle of regression controlled. Figure 29 illustrates the comparison of average responses in each major category between the control and treatment groups.

The second test was for the equivalence of variance between the control and treatment groups at the time of the pretest. This equivalence is a condition of the first test, allowing the parametric statistical test to be used. The results of this test are contained in Appendix J. For each question, the variance of the responses of the treatment group was compared to the variance of the responses of the control group. For all but four questions, the two samples were found to be the same, at the precision level alpha of 0.05. The treatment and control group were then declared to have equal variance for the purposes of this experiment, supporting the assumption of the first test.

The third test was for the degree of change between the control and treatment groups from the pretest to the post-test. Measuring this degree of change was the objective of the experiment. The results of this test are contained in Appendix K. For each question, the average change in

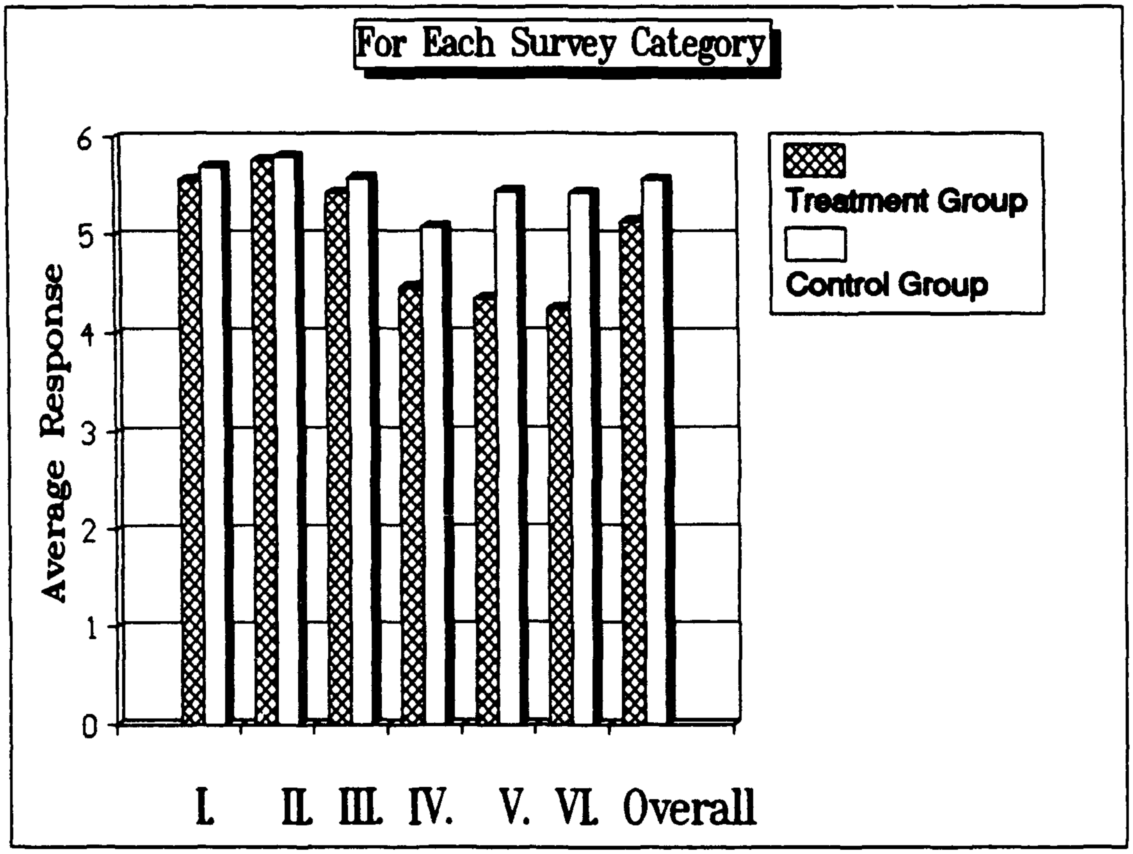


Figure 29. Group Pre-Test Comparison

response of the treatment group was compared to the average change in response of the control group. For all but two questions, the two samples were found to be the same, at the precision level alpha of 0.05. The treatment and control group were then declared equal for the purposes of this experiment. No difference in change in attitude toward the six quality categories was found over the course of this case analysis and experiment. Figure 30 illustrates the comparison of average change in responses in each major category between the control and treatment groups.

The forth test was for the equivalence of variance between the control and treatment groups' change in responses associated with the third test. This equivalence is a condition of the third test, allowing the parametric statistical test to be used. The results of this test are contained in Appendix L. For each question, the variance of the responses of the treatment group was compared to the variance of the responses of the control group. For all but eleven questions, the two samples were found to be the same, at the precision level alpha of 0.05. The treatment and control groups could not be declared to have equal variance based on this test. However, the matter was not pursued to the extent of performing non-parametric tests.

Discussion. No difference was found in change of attitude toward quality between the treatment and control groups. The treatment group was exposed to initial training

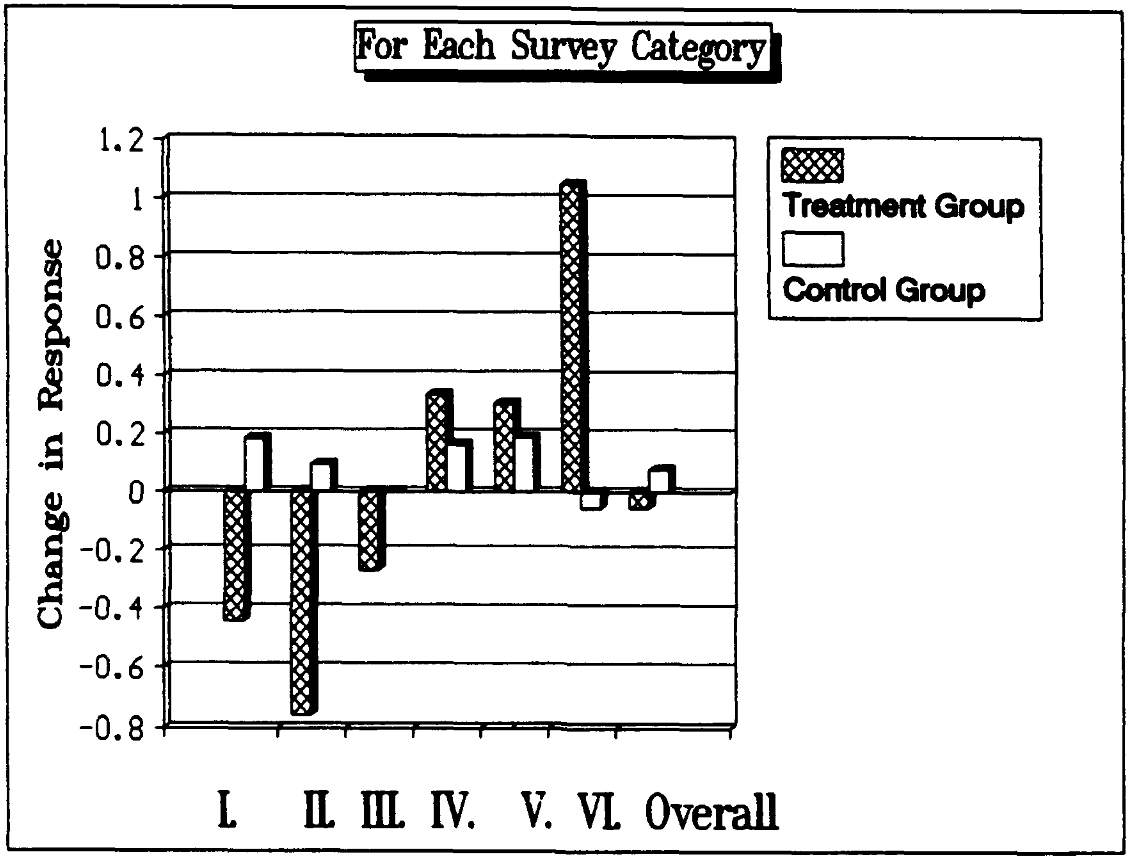


Figure 30. Survey Results

in process improvement techniques. They participated in seven months of meetings using these techniques to improve the design review process. The control group was not exposed to any unordinary training or techniques. And yet when given the post-test, the control group showed a change in attitude toward the quality categories little different than the treatment group. Several reasons are possible for this lack of difference.

Table 19. Possible Reasons for Lack of Difference

1. Time between pretest and post-test
2. Inadequate culture change training
3. Participation does not change attitude

The period of time between the pretest and post-test may not have been long enough to observe significant attitude changes in the treatment group. Performance management has been described earlier as needing a long term commitment. Short term results are not to be expected. The seven months between the pretest and the post-test may have been insufficient for the culture change that accompanies process improvement efforts to be seen. Culture change is defined as a transformation of viewpoint from "business as usual" to "continuous improvements." If more time had been available between the two tests, perhaps a significant difference between the two groups would have been observed.

This possibility could be tested for by administering another post-test at some later date.

Another possible reason is that the initial training provided to the treatment group did not include adequate emphasis on culture change. The training provided was completed in twenty minutes at the first team meeting. An introduction to process flow-charting and brainstorming techniques was all that was included. Perhaps more of an emphasis needed to be made on change of attitude to one that is most conducive to performance management. Without this emphasis, the treatment group may not have had sufficient exposure to the broad spectrum of quality issues to result in changed attitudes. This could be tested for by testing a similar implementation of performance management in another organization where initial training includes culture change training.

An additional potential reason for the lack of difference in attitude change is that the performance management framework followed does not need or produce attitude change. Engineers by profession are trained in problem solving. The subjects of this case analysis and experiment have, as engineers, been taught to seek quality and better ways to solve problems. It may be that the need for a cultural change prior to successful performance management in an engineering environment is not critical. However, a generalization of this nature cannot be made on the basis of the results of this experiment alone. Significant additional testing of other engineering applications of performance management would be required.

Summary

A performance management team was used to evaluate and improve the Corps of Engineers design review process. Improvements that resulted from this team effort are summarized in Table 20. The observations of the experiences of the team were catalogued and assigned to subjects. Principles were then synthesized from these observations.

Table 20. Results of Performance Management Team

1. Representation on Selection Committee
2. Creation of Plan Room for Review
3. Consolidate the Branch Design Review Point of Contact
4. Prepare User Review Checklist
5. Suggest Review Meeting with DEM Shops
6. Open Communications with Environmental Management

These principles were compared to the information gathered in the review of literature. From this comparison, recommendations will be made in the next chapter.

V. Conclusions and Recommendaations

Overview

This chapter presents recommendations drawn from the research reported in Chapters II and IV. These recommendations include suggestions for more effective implementation of performance management. In addition, hypotheses to be tested in future research are proposed. Finally, the conclusion of this research is stated and supported.

Recommendations

Name of Improvement Effort. Much of the activity in the area of performance evaluation and improvement has gone under the name of Total Quality Management (TQM). The Department of Defense used this name in directing the Services to adopt a framework for the management of performance (Department, 1989b). The name used in this thesis has been "Performance Management Framework." While a name does not a program make, it is important to note the reaction of personnel in Air Force Civil Engineering to the name TQM. Statistical process control and X-bar charts often come to the minds of people familiar with TQM when they hear the name. These statistical tools are important to TQM in the manufacturing environment. The usefulness of these tools in the design environment has not been as well established. To give the performance management effort a chance to get off the ground, a name without negative preconceptions to engineers needs to be selected.

The Air Force Civil Engineering and Services community has decided to use the name "Engineering and Services Quality Management Program" (Ahearn, 1990). This identifies the effort with the engineering community. It also distinguishes the effort from stock TQM. Maintaining this distinction is recommended.

ENGINEERING AND SERVICES

QUALITY MANAGEMENT PROGRAM

Figure 31. A Name for the Engineering Improvement Effort

Use of Training Course. The Performance Management Framework Training Course developed in this research and presented in Appendices A, B, and C is uniquely suited for use in the base level Engineering Branch environment. While dozens of guides for TQM exist, and even several aimed at service organizations, none are tailored to Air Force Civil Engineering as this one is.

This training course is designed to assist Engineering Branch managers, engineers, and others who contribute to the preparation and execution of projects for real property construction, maintenance, and repair. These individuals are challenged with providing and maintaining quality facilities for Air Force organizations to perform their missions. Evaluation, management and improvement of the performance of Engineering Branch personnel is central to continuing to fulfill this mandate.

Table 21. Performance Management Framework Objectives

Foster a management perspective conducive to performance improvement
Create an organizational environment promoting performance improvement
Continually encourage the quest to discover and implement ways to improve performance

The objectives for use of a *framework for performance management* are listed in Table 21. The objectives of the training course which presents such a framework are listed in Table 22.

Table 22. Training Course Objectives

To equip civil engineering personnel to manage the Performance Management Framework
To create momentum for performance improvement
To promote within civil engineering personnel a perspective for improvement
To provide the essential tools and techniques to establish and maintain a Performance Management Framework

The goal of this training and the handbook which accompanies it is to acquaint Engineering Branch members with a framework for managing performance and to provide the tools needed to use this framework. It was designed to be taught by a member of the Engineering Branch. This person does not need an extensive background in performance management nor experience in teaching. A few hours time in advance to become familiar with the contents of the course are all that are required. However, a course leader with background or experience in either of these would likely be more effective than a novice.

The training course is designed to be three days in length, eight hours each day with an hour for lunch. The material is presented through a mixture of group interaction and exercises that encourage experiencing the principles as they are discovered. The course is to be hosted at the squadron location, to allow the Engineering Branch members to learn in their own environment, and to minimize disruption to their routine.

This course was developed based on experiences and lessons learned in the implementation and use of a framework for performance management in an actual Engineering Branch environment. Air Force engineering organizations may use this course in conjuction with other training available from the Air Force Civil Engineering and Services Center to begin a squadron-wide performance management effort. Contact Ray

Hatch, AFESC/DEMG, Tyndall AFB, Florida, AV 523-6401 for further information on other training materials.

The course presented in this research is available at little cost to the interested organization. No teams of consultants are needed. The course may be taught with materials and personnel already present in the Engineering Branch. It provides the tools, place to get started and attitude for improvement that are needed to begin improving the way work is accomplished in the Engineering Branch at base level.

Several characteristics distinguish the training provided by this course from other training available. These are the reasons this training course might be chosen over other alternative ways to implement a performance management framework in civil engineering. First, this course recognizes the unique nature of the engineering environment. The fact that the engineer's product is ideas and designs is accounted for. Second, the crucial importance of management commitment and direction is emphasized. Management involvement from the outset is critical to assuring that lasting improvements are made (Edosomwan, 1987:67-8). Third, the course stresses creative ways of measuring the output of engineering which is often difficult to quantify. For performance management to be effective, a system of measurement is essential for monitoring the work processes before and during the improvement efforts (Dingus and Hrivnak, 1988:30). Fourth, the target of improvement is defined as more than just the quality issues which are stressed in other training. The broader goal of performance, including quality but also productivity, effectiveness and efficiency needs to be the target in civil engineering (Armentrout, 1986:142-144). Fifth, the course develops the issue of training, to provide individuals the tools and attitude needed to participate with others in improving their work. Training is an element of performance management which cannot be neglected, for both the team members and the leaders and facilitators (Todd, 1990). Finally, the innovative process viewpoint on work allows the activities of the workplace to be understood, and consequently improvement proposed that get to the root of the problem (Kacker, 1988:41).

Table 23. Advantages of This Training Course

1. Recognizes the unique nature of civil engineering
2. Emphasizes management support and direction
3. Stresses ways to measure engineering performance
4. Defines broad goal of improvement beyond quality
5. Develops training objectives for tools and attitude
6. Presents process viewpoint of work activities

Performance Improvement Teams. A fundamental concept of performance management is participation. This means getting the workers involved in evaluating and improving their jobs. These people are the ones most familiar with their work and the problems they face, and so are often more aware of what improvements are possible than management is. Using a team approach also encourages more creative solutions to problems, as the group can bounce thoughts around to come up with new ideas (Todd, 1990).

A team can formed all from the same functional area, or represent a functional cross-section, as appropriate for the work process being addressed. From five to eight members are ideal. These members might be volunteers or hand-picked by management to bring the needed experience and knowledge to the team. The team will meet together over a period of time, usually once a week, to collectively study and propose solutions to a work process or problem the organization has identified. When their recommendations are complete, their proposals are presented to management. Management must then demonstrate their support and commitment to the effort by implementing actions recommended by the team, and recognizing the team's efforts through awards and publicity. The team is then disbanded, their job complete, or assigned a new process or problem (Todd, 1990).

Scope of Pilot Project. The basic pattern for performance management is to establish a performance improvement team to propose and implement improvements in a work process. A temptation will be to start on the most problem-plagued, complex work process the organization has. This can lead to discouragement of the team and failure of the improvement effort. The newly formed performance improvement team should be allowed to focus on a less complicated but still important process to begin with. This is often called a pilot project. With this experience under their belt, the team, or even another team, is better able to proceed on to more difficult challenges.

Hypotheses for Further Research. This research effort was qualitative in nature. As such, it sought to increase the body of knowledge in existence on the subject of performance management in civil engineering. A stated goal of this research was to develop hypotheses for further research. The nature of this subject was not well enough understood to propose any reasonable hypotheses to be tested in this research. Having developed the subject through this research, several hypotheses can now be proposed.

Hypothesis: Using the training course presented herein will result in saving more resources than are expended in the first year. This would be tested by selecting a sample population of base level Engineering Branches and using the course. The manpower and material resources needed for training and implementation would be recorded. The resources saved due to improved performance would be determined by the measurement systems created as a result of the performance management framework itself. The resources expended would be compared to those saved to test whether the hypothesis is supported.

Performance Management Framework

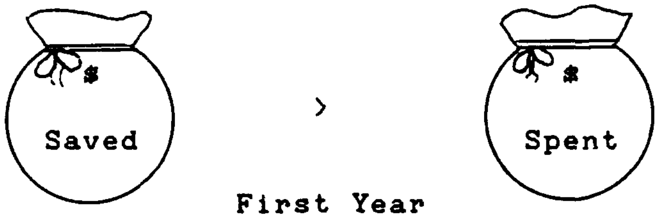


Figure 32. Training Course Hypothesis

Hypothesis: The name Total Quality Management carries an unfavorable impression to engineering managers. Related hypothesis: The extent of the unfavorable impression created by the name TQM is inversely proportional to the individual's degree of knowledge of TQM. These could be tested using a survey instrument. The survey might ask for responses to statements of the usefulness of various principles of performance management. Some of the statements would include the name TQM while others would not. The difference in response between those with the name and those without could be measured. The survey could also include some questions to determine the individuals knowledge and exposure to TQM. These results could be correlated with any difference in response to the previous statements.

Hypothesis: The degree of perceived management support among the performance management team members will correlate to the team's effectiveness. This could be tested by using a short survey instrument to measure the team members impression of how well management supported their efforts. The resources saved resulting from the team's improvement recommendations could then be determined using the measures proposed by the team in the performance management framework. A correlational statistical study could be performed to determine if in fact the hypothesis is supported. Regression could be used to develop the relationship between management support and effectiveness, as illustrated in Figure 33.

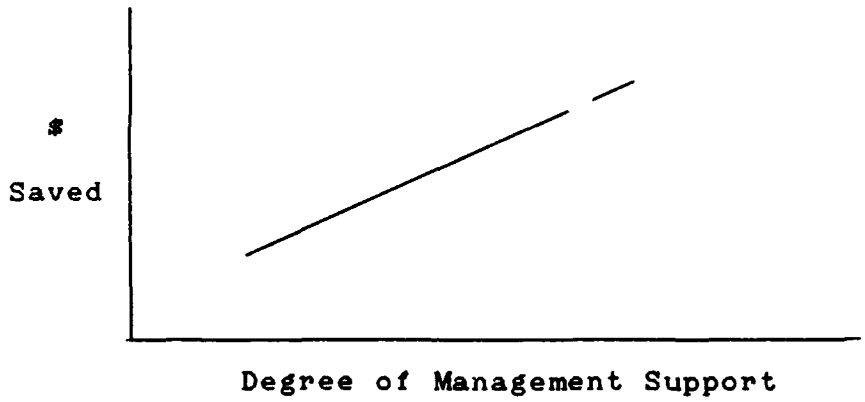


Figure 33. Management Support Hypothesis

Hypothesis: Engineers have a higher initial appreciation and understanding of quality, and commitment to quality work, than other career fields. This results in less cultural change training being required with engineers than with others. One goal of cultural change training is to alter individuals attitudes toward quality and convince them of the importance of quality improvements. This could be tested by comparing the effectiveness of performance management in an engineering environment with its effectiveness in other settings. Various degrees of cultural change training could be provided in each case. Measures would need to be established for quantifying the effectiveness of performance management.

Hypothesis: Change in attitude toward quality will accompany successful implementation of performance management in an organization. This change in attitude will become more pronounced as time progresses from the date of the implementation. This could be tested by continuing to administer the Quality Questionnaire (Hayman and Schneider, 1989) to a treatment and control group at regular intervals after implementation in the treatment group. Regression analysis could be used to measure the trend, if any, in attitude change for each group and compare the trends.

Answers to Investigative Questions

In the training course developed and the recommendations listed above, the investigative questions have been answered. Following is a brief summary.

How has TQM been utilized in other similar organizations? What benefits have been achieved? What changes need to be made to adapt TQM to the Contract Engineering Branch? TQM has been used extensively in the manufacturing environment, especially in Japan. Attention is now being paid to using the same principles in the service or government environment. The TQM tools and attitude need to be adapted to civil engineering by accounting for the unique nature of civil engineering, emphasizing management support and direction, and stressing ways to measure engineering performance. The broad goal of improvement needs to be defined as performance, which encompasses more than just quality. Training objectives for the tools and attitude required must be developed, and the process viewpoint of work activities presented.

What opportunities and needs exist within the Engineering Branch for improvement? The work activities of an Engineering Branch can be assigned to the processes to which they contribute. Any of these processes can be evaluated and improved using performance management. The design review process is just one example analyzed in this case. Some potential processes for improvement using a performance improvement framework are listed in Table 24.

Table 24. Engineering Branch Processes

Design Review
Contract Management
Project Programming
Change Order Management
Accomplishment of
In-house Design

__What training of personnel is used prior to or during implementation of TQM?__ Training must include emphasis on both tools and attitude. Cultural change training seeks to alter the viewpoint of the employees and prepare them to seek improvements. Training in specific group problem solving tools is needed to allow the group to participate as a team in evaluating and improving their work processes. This training needs to be targeted at the people most likely to use it, and not just given to all indiscriminately.

__What obstacles are encountered during the initial implementation of TQM?__ An obstacle encountered in the engineering environment are the project rather than product orientation of engineering. Another is the frequently changing requirements that users place on the Engineering Branch. A third is the difficulty in measuring the output of an engineering organization. Inadequate management commitment and people's prejudices against change are other potential obstacles.

__What short range benefits can be measured after implementation of TQM?__ Short range benefits include gaining a better understanding of the work activities in organizations. Some obvious improvements can be made immediately upon discovering them in the evaluation process as well. These benefits can be measured in decreased time spent in wasted energy.

What outside resources (i.e. private contractors or procured training) are needed to facilitate the performance management effort? No outside resources are required for training or facilitation. The training course developed in this effort can be used at little cost and with none other than the personnel available to the squadron.

How do attitudes toward quality of work change among employees involved in performance management? In the short term, six months, no change in attitude was measured in the case analyzed in this work. Over a longer time interval such changes might become apparent.

How is a performance management framework used to guide improvement efforts in the particular situation of an Engineering Branch? Performance management can be used quite effectively in an Engineering Branch. First, top management must be committed to support and direct the effort. They must provide training to the people who will be involved. Management must further pick a work process to be evaluated and improved and choose a team to look at it. This team must follow a structured procedure for problem solving. They must understand the work process involved, and the steps it contains. The team then identifies problems which plague this process, and proposes solutions to these problems. Finally, the team recommends actions for implementation to management. The cycle is then completed when management approves improvement changes be made. The participants in the effort are rewarded, and the organization is ready to begin again with a new team and process. As performance management becomes more familiar, several of these cycles might be going on simultaneously.

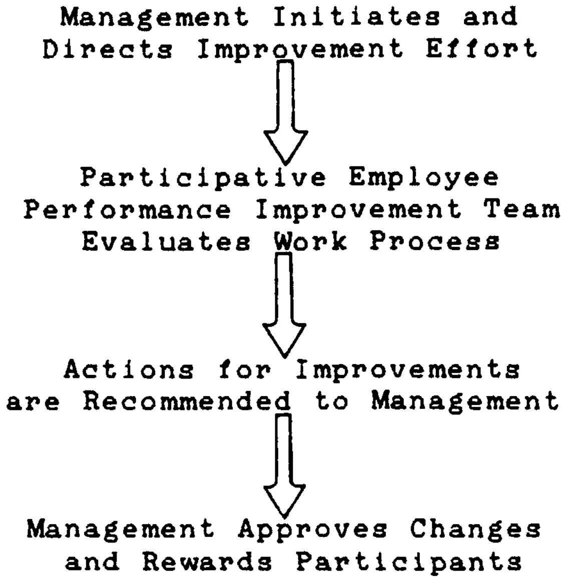


Figure 34. Performance Management Framework

<u>What guidance do Engineering Branch managers need to design and implement a performance management framework in their organizations?</u> Managers need specific guidance in how to implement performance management. This guidance includes who and how to train, the importance of management support and direction, and a way to get an improvement effort started. The guidance for an Engineering Branch manager needs to consider the particular characteristics of the Air Force engineering environment. If guidance is used that was

designed for operational organizations on the Air Force base, the effort may not be successful. The training course presented here is tailored specifically to the engineering environment, provided the guidance the Engineering Branch manager needs.

Table 25. Guidance Needed by Engineering Branch Managers

1. Who and how to train
2. Importance of management direction and support
3. Starting point for the improvement effort

Conclusion

Performance management is a powerful concept which promises substantial increases in the quality and effectiveness of an organization's work, together with decreases in costs. These gains are accomplished by using employee work teams to evaluate work processes and eliminate waste and errors. The concept has proven successful in a number of work situations, both manufacturing and service, public and private.

The Engineering Branch in a base level Civil Engineering Squadron can benefit from performance management. The work processes which make up the activity of the Engineering Branch are suited for analysis using the process improvement techniques. The engineers themselves are already trained problem solvers. They just need to have their talents directed toward improving the way they work. This direction is provided by the performance management framework.

A need for a framework for performance management for the base level Engineering Branch motivated this research. The opportunities and desire existed to improve the organization's work processes. Lacking were the attitude, tools, and starting point needed to create a successful improvement effort. This research followed and documented the use of performance management in an Engineering Branch environment.

A performance management team was implemented at the Engineering Branch of the 2750 CES at Wright-Patterson Air Force Base. The team focused on the process of reviewing projects designed by Architect-Engineers and the Corps of Engineers. As a result of this team effort, improvements to the process were made. More timely and better comments were being provided to the designers after the improvement actions.

From the experiences gained in the analysis of this case, a three day training course was developed. This course was created to provide the tools and attitude needed to begin performance management efforts in other Engineering Branches. The course was designed to provide a starting point, and is a guide to the performance management effort.

Appendix A. Plan of Instruction

This appendix contains the Plan of Instruction for a three day training course in performance management. The Student's Handbook and Leader's Guide for the course are given in Appendix B and Appendix C respectively.

The objectives, schedule and scope are presented here. A general lesson plan is given for each of the eighteen lessons. Each lesson plan includes objectives and an outline of the subjects discussed in that lesson.

PLAN OF INSTRUCTION

Course Title: Civil Engineering Performance Management Framework Training

Objective: To motivate and equip supervisors and project management and support personnel in the Engineering Branch of Air Force Civil Engineering Squadrons to implement the Performance Management Framework.

Audience: This course is designed to be presented to the Chief of Engineering, Chief of Design, Chief of Construction management, Chief of Programming, Chief of Drafting, and engineers, secretaries, technicians and other members of the Engineering Branch as desired. Group size of seven to fifteen members is recommended.

Scope: The course is designed to last three days, with seven hours of training each day. Each hour should include a five to ten minute break. The leader's guide provides enough information for a member of the Engineering Branch to conduct the training with nominal preparation. No formal leader training is required.

Materials: One leader's guide and sufficient student's guides for all the members of the training group are required. Additionally, an overhead projector and clean transparency film, or a flip chart with clean pad of paper, along with colored pens are needed. Additional material requirements are noted in specific lessons.

Contents:

Lesson	Description	Time
	Day 1	
01	Introduction/Distinctives	1 hour
02	Benefits Available	1 hour
03	Management Commitment	1 hour
04	Management Support	1 hour
	Lunch	1 hour
05	Team Participation	1 hour
06	Participation Exercise	2 hours
	Day 2	
07	Training Objectives	1 hour
08	Training Techniques	1 hour
09	Process Improvement	1 hour
10	Process Flow Exercise	1 hour
	Lunch	1 hour
11	Process Flow-charting	1 hour
12	Performance Definition	1 hour
13	Performance Components	1 hour
	Day 3	
14	Implementation Details	1 hour
15	Implementation Exercise	3 hours
	Lunch	1 hour
16	Measurement Exercise	1 hour
17	Cause and Effect Discussion	1 hour
18	Objectives Matrix	1 hour

Lesson 01	Introduction/Engineering Environment Distinctives
Time:	1 hour
Objectives:	Distinguish the Performance Management Framework from other management fads and gimmicks which have come and gone. Communicate that this program is one which civil engineering personnel design themselves to fit their own particular situations.
Technique:	Group brainstorming - Have group generate and discuss features of other management schemes and what problems plagued them. Continue by describing how the Performance Management Framework can overcome these problems.

Lesson Plan:

Introduction	5 min
Ice Breaker/ Stage Setter - Management Techniques	10-15 min
Components of a Successful Management System	5-10 min
Roadblocks to Successful Management Systems	5 min
Course Overview	
Framework Objectives	2 min
Course Objectives	2 min
Engineering Environment Distinctives	5 min
Role of Management Employee Participation Training Target of Improvement	5 min
Process Framework Framework Implementation Measurement	5 min
Review Framework Objectives	1 min

Lesson 02	Potential Benefits from Performance Improvement
Time:	1 hour
Objectives:	Detail what benefits can be gained. Demonstrate why improvement action is needed. Understand benefits experienced in another workplace environment. Discuss differences in the civil engineering environment that may require adaptation or changes of approach from that used successfully in other situations.
Technique:	Small team case analysis - Critical evaluation and discussion of cases by small teams with presentation of conclusions to complete group.

Lesson Plan:

Introduction	2 min
Case Evaluations (3 cases)	23 min
Reports (5-8 min each)	20 min
Application (Time permitting) - Needs for improvement in this organization	5 min

Lesson 03	Importance of Commitment by Top Management
Time:	1 hour
Objectives:	Demonstrate that management commitment is crucial. Identify ways that management commitment can be increased.
Technique:	Paired individuals case analysis - Study cases and determine the nature and extent of management commitment. Suggest how and why top management could be convinced to support the Performance Management Framework more fully.

Lesson Plan:

	Introduction	5 min
	Case Evaluations (5 cases)	20 min
	Reports (3-5 min each)	20 min
	Application - Commitment of top management for this organization	5 min

Lesson 04	Management Support and Cultural Change
Time:	1 hour
Objectives:	Identify the support roles of management in implementing and maintaining a Performance Management Framework. Define the concept of 'Cultural Change' and communicate the essential role of top management in creating the change in culture from the top down.
Technique:	Structured group discussion - Lead the group through an outlined format presenting the important features of management support and cultural change, allowing the group to contribute insights and ideas.

Lesson Plan:

Review and Introduction	3 min
Management Support Roles	
Provide Example	5 min
Provide Resources	3 min
Coordinate Organization-Wide Efforts	5 min
Reward Results	2 min
Cultural Change	
Your Organization's Culture - Man from Mars Perspective	20 min
Change	3 min
Formal Channels	3 min
Informal Channels	4 min
Conclusion and Summary	2 min

Lesson 05 Teamwork and Participation Concepts

Time: 1 hour

Objectives: Establish the ability of a team to do more than the individual can in the subjective area of performance improvement planning.

Identify the types of groups: work area teams or multi-functional cross disciplinary teams. Discuss the effect of group size on group dynamics.

Present common problems plaguing groups. Teach team members to expect them, identify them, and correct them.

Technique: Group brainstorming - Allow the group to generate and discuss ideas about group effectiveness and difficulties. Provide guidance as needed to direct group in covering the principal concepts listed.

Lesson Plan:

Introduction	3 min
Group Decision Making	
Compared to Individual	12 min
Group Structure	
Composition	8 min
Size	7 min
Group Roles	12 min
Conflict	8 min

Lesson 06 — Team Participation Exercise

Time: 2 hours

Objectives: Allow the group members to work as a team to solve an assigned task. Give the individuals an opportunity to observe group interaction techniques and problems.

Discuss the dynamics of the group exercise. Identify specific roles that people adopt in a group environment to facilitate performance.

Technique: Group exercise - Lead the group through the Farmer Exercise. Discuss the results. Prompt the discussion by asking about specific roles team members were observed to adopt.

Lesson Plan:

Farmer Exercise	50 min
Break	10 min
Evaluation	
Review Objectives	2 min
Importance of Individual's Contribution	5 min
Understanding and Identifying Roles	28 min
Facilitators	
Introduction	5 min
Response to Roles	10 min

Lesson 07 Training Objectives and Pitfalls

Time: 1 hour

Objectives: Establish the broad training goal of creating the cultural change needed for a successful program. Define the more specific training goals of imparting tools for use in the Performance Management Framework.

Introduce some of the most common problems and errors encountered in training programs.

Technique: Group brainstorming - Encourage the group to suggest objectives and problems of training. Provide guidance as needed to direct the session through the important concepts listed.

Lesson Plan:

Introduction	10 min
Cultural Change Training	15 min
Specific Tools Training	10 min
Problems	15 min

Lesson 08	Training Techniques and Strategies
Time:	1 hour
Objectives:	Identify which individuals in the Engineering Branch should receive training. Suggest what factors are pertinent to choosing these people. Determine the most opportune time to provide various degrees of training. List important criteria in selecting this correct time in different situations. List the essential ingredients to be included in the training curriculum. What situational factors might require revising these ingredients?
Technique:	Small team presentations - Provide each of three teams with a list of questions and objectives. The team will generate recommendations and present them to the group.

Lesson Plan:	Introduction	3 min
	Team Project	32 min
	Presentations	15 min

Lesson 09	Process Improvement
Time:	1 hour
Objectives:	Present the concepts associated with viewing organizational activity from a process perspective. Understand the five principal features of process improvement plans. Define cross-functional processes. Establish how to determine input and output which flows between these producers and consumers. Discuss ownership of processes. Show the importance of assigning responsibility for a process to a single individual. Communicate the necessity of extending the process to its origin and conclusion. The greatest improvements for the least expense can often be made by thorough planning at the start of the process.
Technique:	Structured group discussion - Follow the format provided, encouraging the group to expand upon and define terms and concepts essential to understanding the process perspective.

Lesson Plan:	Introduction	3 min
	Process Perspective	7 min
	Process Improvement Plans	15 min
	Cross-functional Processes	10 min
	Process Ownership	5 min
	Process Extension	10 min

Lesson 10 Process Flow Exercise

Time: 1 hour

Objectives: To allow the group to identify a process in a multi-functional environment. The process interfaces will be determined, along with the input and output passed between these functions.

Technique: Group brainstorming - Suggest a situation the members of the group will be familiar with, perhaps getting up in the morning, getting ready and getting to work. Have the group flow the process. Ask the group to extend the process to its extreme beginning and conclusion. Discuss how actions taken at the beginning can dramatically affect the outcome.

Lesson Plan:

Introduction	3 min
Process Excercise	
Introduction	2 min
Process Flow Diagraming	15 min
Cross-functional aspects	
Function Identification	6 min
Input Identification	6 min
Output Identification	6 min
Ownership	2 min
Extension	10 min

Lesson 11	Process Flow-charting
Time:	1 hour
Objectives:	To provide further experience in describing the underlying processes comprising the workplace.
Technique:	Panel Discussion - Assign one of four case studies to each individual. After allowing time for reading and considering the case, call panels of individuals who had the same case to identify the central process(es) described. Emphasize the cross-functional nature of the processes. Describe the input and output at each interface.

Lesson Plan:	Introduction	5 min
	Read Cases	5 min
	Panel Discussion	36 min
	Conclusion	4 min

Lesson 12	Definition of Performance & Customer Satisfaction
Time:	1 hour
Objectives:	List and define the seven components of performance. Discuss which are most appropriate for the Engineering Branch. Understand the important role of customer or user satisfaction in improving performance. Identify who customers are of the Engineering Branch.
Technique:	Group brainstorming - Present the seven components of performance. Allow the group to suggest the value of each in their environment. Permit the group to generate a list of customers and how the Engineering Branch serves these customers.

Lesson Plan:

Introduction	5 min
Performance Component Definition	
Effectiveness	4 min
Efficiency	4 min
Productivity	4 min
Quality	4 min
Innovation	4 min
Quality of Work Life	4 min
Budgetability	4 min
Component Importance	2 min
Customer Satisfaction	
Importance of Customers	5 min
Identification of Customers	10 min

Lesson 13	Application of Performance Components
Time:	1 hour
Objectives:	Apply the components of performance to the Engineering Branch environment. Suggest elements of performance which could be targeted for evaluation and improvement under the Performance Management Framework.
Technique:	Paired individuals analysis and presentation - Direct each pair to critically evaluate their organization in regard to one of the components of performance. Their conclusions will then be briefed to the group.

Lesson Plan:	Introduction	5 min
	Paired application analysis	25 min
	Presentations	20 min

Lesson 14	Implementation Details
Time:	1 hour
Objectives:	Outline the steps involved in a top-down implementation of a Performance Management Framework. Illustrate the technique of using a pilot project to initiate the program. Describe the importance of the facilitator to the operation of the team function.
Technique:	Paired individuals' reports - Assign one of the objectives to each pair. Provide guidance from which they can prepare recommendations. Have each pair present their findings to the entire group.

Lesson Plan:	Introduction	3 min
	Paired individual analysis	25 min
	Presentations	20 min
	Conclusion	2 min

Lesson 15	Implementation Exercise
Time:	3 hours
Objectives:	Provide a situation in which members can experience implementation of the Performance Management Framework. Discuss the lessons learned and how they might be applied to the program implementation in the Engineering Branch Environment.
Technique:	Direct the group in participation in the Project Workshop. Lead the group in discussing their experience.
Materials:	Several dozen 8-1/2 x 11 sheets card stock or other heavy construction paper (buff color is fine), masking tape, unsharpened pencils, typing paper, scissors, 12 inch scales, drafting triangles.

Lesson Plan:

Introduction	5 min
Exercise	
Situation	30 min
Management Initiation	15 min
Break	10 min
Team Time 1	25 min
Team Time 2	25 min
Break	10 min
Team Time 3	25 min
Management Implementation	10 min
Debrief	15 min

Lesson 16	Measurement Exercise
Time:	1 hour
Objectives:	Understand the importance of measurement in evaluating and improving performance.
	List reasons for measuring.
	Define what to measure as the products which pass between steps in the process, from internal suppliers to internal customers.
	Examine a method for analyzing variance between these steps.
Technique:	Ham and Cheese Sandwich exercise - Guide the group in the exercise and discussion of applications.

Lesson Plan:	Introduction	3 min
	Measurement	
	Importance	3 min
	Reasons for	6 min
	Variance	
	External	3 min
	Internal	5 min
	Variance Matrix	30 min

Lesson 17	Cause and Effect of Measurement
Time:	1 hour
Objectives:	Understand the importance of measurement, and the components of an effective measurement system.
Technique:	Group brainstorming - Have the group develop a cause and effect diagram for an effective measurement system.

Lesson Plan:	Introduction	3 min
	Cause and Effect Technique	17 min
	Cause and Effect of Measurement	30 min

Lesson 18	Objectives Matrix
Time:	1 hour
Objectives:	Demonstrate a technique to summarize non-related measures into a composite score. Describe the distinction between product, process and surrogate measures, and the advantages of each.
Technique:	Individual Module and discussion - Have each individual complete the worksheet module illustrating the objectives matrix. Allow the members to discuss its use and application.

Lesson Plan:

Introduction	7 min
Types of Measures	8 min
Objectives Matrix Worksheet	25 min
Discussion	10 min

Appendix B. Student's Handbook

This appendix contains the Student's Handbook for a three day training course in performance management. It follows the Plan of Instruction given in Appendix A. Detailed instructions for how to lead a class through the training course are contained in the Leader's Guide in Appendix C.

An introduction and schedule of instruction are given. Objectives for the course and each lesson are given. Where appropriate, outlines for the lessons are given with room provided for note taking. The Student's Handbook is intended to be provided to each student at the beginning of the course. The student would then be allowed to take the handbook with him or her at the conclusion of the course as a reference.

In preparing this handbook, material was adapted from other sources as appropriate. This material is referenced below:

Session 2	Case Descriptions (Hayes, 1990:19-24).
Session 3	Management Cases (Wertz, 1989; Warmington, 1988; Simmons, 1990:74-76; Barra, 1989:46-50)
Session 5	Group roles (HQ AFLC, 1989d:120-121). Conflict responses (Gray and Smeltzer, 1989:412-413).
Session 9	Process improvement plans (Jennings and others, 1989:12-89).
Session 12	Performance components (Sink and Tuttle, 1989:171-186).
Session 16	Variance matrix (Jennings and others, 1989:50-57).
Session 17	Cause and Effect (Department, 1989a:51).
Session 18	Objectives matrix (Riggs, 1987:648-660).

PERFORMANCE MANAGEMENT FRAMEWORK HANDBOOK

A handbook for the evaluation and
improvement of performance in the Engineering Branch of
Air Force Civil Engineering Squadrons

FOREWARD

This handbook is designed to assist Engineering Branch managers, engineers, and others who contribute to the preparation and execution of projects for real property construction, maintenance, and repair. These individuals are challenged with providing and maintaining quality facilities, allowing Air Force organizations to perform their missions. Evaluation, management and improvement of the performance of Engineering Branch personnel is central to continuing to fulfill this mandate.

The goal of this handbook and the training which accompanies it is to acquaint Engineering Branch members with a framework for managing performance and to provide the tools needed to use this framework.

Performance Management Framework Objectives:

Foster a management perspective conducive to performance improvement

Create an organizational environment promoting performance improvement

Continually encourage the quest to discover and implement ways to improve performance

Course Objectives:

To equip civil engineering personnel to manage a performance management framework

To create momentum for performance improvement

To promote within civil engineering personnel a perspective for improvement

To provide the essential tools and techniques to establish and maintain a performance management framework

CLASS SCHEDULE

	First Day	Time	Page
Morning			
Topic:	Introduction/Engineering Environment Distinctives		
Session 1	Introduction/ Distinctives	1 hour	120
Session 2	Benefits Available	1 hour	121
Topic:	Role of Management		
Session 3	Management Commitment	1 hour	126
Session 4	Management Support	1 hour	134
	Lunch	1 hour	
Afternoon			
Topic:	Employee Participation		
Session 5	Team Participation	1 hour	136
Session 6	Participation Exercise	2 hours	140

Second Day		Time	Page
Morning			
Topic: Training			
Session 7	Training Objectives	1 hour	143
Session 8	Training Techniques	1 hour	145
Topic: Process Framework			
Session 9	Process Improvement	1 hour	146
Session 10	Process Flow Exercise	1 hour	149
	Lunch	1 hour	
Afternoon			
Session 11	Process Flow-charting	1 hour	150
Topic: Target of Improvement			
Session 12	Performance Definition	1 hour	151
Session 13	Performance Components	1 hour	157

Third Day			
Morning			
Topic: Framework Implementation			
Session 14	Implementation Details	1 hour	158
Session 15	Implementation Exercise	3 hours	160
	Lunch	1 hour	
Afternoon			
Topic: Measurement			
Session 16	Measurement Exercise	1 hour	162
Session 17	Cause and Effect Discussion	1 hour	168
Session 18	Objectives Matrix	1 hour	170

Session 1 Introduction/Engineering Environment Distinctives

Objectives: Distinguish a performance management framework from other management fads and gimmicks which have come and gone.

Establish that this framework is one which civil engineering personnel design themselves to fit their own particular situations.

List management techniques which the Air Force or your organization have tried. How well have they worked?

What are some essential aspects of a successful management framework?

What are some aspects of management techniques which have not worked or have hampered the effectiveness of the technique?

Session 2 Potential Benefits from Performance Improvement

Objectives: Detail what benefits can be gained.

Demonstrate why improvement action is needed.

Understand benefits experienced in other workplace environments. Discuss differences in the civil engineering environment that may require adaptation or changes of approach from that used successfully in other situations.

Reference: The three case descriptions - "Three Views of TQM," by Glenn E. Hayes, Quality, Volume 29, April 1990, pp 19 - 24.

Questions for Case Evaluations:

What need did this organization identify which they sought to improve?

What action did they take to make improvements? What tools were used? What resources did they tap?

What benefits did they achieve? What improvements were realized?

How did this environment differ from the Air Force Engineering Branch environment you are in? In what ways was it similar?

Would the approach used work in your organization? Why or why not? What would need to be done differently to make improvements to some area of need in your branch? What could be done in a similar fashion?

Case 1. General Dynamics Space Systems Div., San Diego, CA

In 1985, senior managers at General Dynamics decided to use performance management principles to make their division prosper. A quality team was created to examine the organization. Work processes were found which were stuck in the trap of always doing things the same without questioning whether there was a better way. An atmosphere was created to encourage making changes without workers fearing reprisals.

The success of the performance improvement effort was attributed to a large degree to the support and direction provided by the top management. This group showed leadership, not just management, in making sure the employee improvement teams had all they needed to tackle nagging problems and bring misunderstood work processes to light.

Decisions were made about training, including who, what, when and how. Senior management sought training in how to provide a more favorable environment in which the workers could proceed with the performance improvement efforts. Management's commitment was shown further by making sure everyone else also received the training they needed in order to begin. Then management stood back and let teams of workers dive into evaluating and improving their work processes using performance management techniques.

As a result, the team's departments are now working together in better harmony. The material procurement, manufacturing, production and quality departments are functioning more as a single unit. They communicate more frequently and effectively. Costs have been reduced by as much as 30% as well. Improvements were made not only on the factory floor, but in the administrative processes. Prior to using performance management, their work to produce launch vehicles and to provide launch services was understood only from an engineering viewpoint. However, it took the new techniques and mindset of performance management to understand the work from a process viewpoint. This allowed the process to be charted and areas needing improvement to be exposed.

The improvements with the largest potential impacts were those focused not on production floor but on the administrative functions. Paperwork processes were found to have the longest cycle times. Shortening these turnaround times proved more important than the more direct production work processes.

Case 2. TRW Space & Defense Sector, Redondo Beach, CA

In mid-1989, TRW set goals for the sector into the new decade and chose performance management as a way to help reach these goals. One reason given was to meet their customers' expectations. A growing commitment to performance management principles exists in government, with whom much of their work is done. They did not want to fall behind their competitors, many of whom have begun such efforts. A second reason given was the bureaucratic nature of their business. Work processes needed to be improved to reduce the time and cost associated with this business bureaucracy. Wasted steps were to be cut out of the processes, promising savings of up to 30%. Worker motivation would be increased as individual responsibility was restored and waste eliminated.

Top management supported performance management by promoting the mindset needed to look for improvement, not just to get by. Involvement by every manager was expected. Each was to be receptive to improvement ideas and encourage the efforts of their people. Further support was provided in the form of resources needed to implement improvement teams and their ideas.

Performance management was formally begun when all senior managers attended training in how to lead the effort. Process action teams were formed and training provided for their members. These teams were directed to evaluate and propose improvements in the work processes of the organization. A goal of 30% cost reduction over several years was set. Each department was made responsible for a portion of that goal each year.

Accomplishments were made in both production oriented and idea oriented processes. Six processes that were initially attacked were: 1)travel expense reports; 2) Time card processing; 3) New hires and transfers; 4) Facilities requests; 5) Performance measurement systems; and 6) Administrative support requests. Each was marked by bureaucracy, and improvements were made by streamlining the processes and removing areas prone to mistakes.

The sector made sure that improvements in schedule, performance or cost were not made at the expense of quality. A focus was maintained of improving the work processes, and not just trying to dress up the products that result. A strong customer involvement was developed, making sure the work was in harmony with customer expectations.

Case 3. M/A-COM Government Systems Div., San Diego, CA

M/A-COM expanded its performance management efforts in March, 1989 as a result of observing improvements previously achieved in a limited use of the principles in its production area. Products were completed with less labor, fewer defects, and lower inspection costs. An additional motivation, as a government supplier, was the government's requirement that all its suppliers use such performance management principles.

Decision making authority was spread to lower levels in the organization. Workers were recognized for their contributions in performance management, setting the example that management was behind such efforts. Top management's active involvement in the improvement efforts was further demonstrated by including the topic and efforts in the executive council agenda for their monthly meetings. Initially, critical work processes to be evaluated and improved were defined by this council. Since then, other processes have been added as a result of suggestions from the employees.

Top management has been involved in activities related to performance management to show their support. Funds have been budgeted for training, which has been provided to all performance improvement teams. The efforts were given publicity through the organization's publications, where teams were credited for their accomplishments.

A consultant was hired to train the employees in the tools, mindset, and concepts of performance management. The plan was publicized to all personnel. Teams have already improved the data-handling process, and the employee suggestion policy is being evaluated. Perhaps one of the most significant accomplishments has been getting employees to work together in teams. Barriers are breaking down and communication improving as they understand their work processes and why others involved in them do the things they do. Not all improvements were large ones, but as long as they are aimed in the right direction they have been welcomed.

A critical element in the team problem solving was to first properly identify the process. This was done using the organization's mission statement and process flow-charting. The urge to jump the gun needed to be controlled. Only after adequate training and thorough process definition could successful efforts be pursued. Using the employees in an interactive, participative team setting has unlocked much potential for success.

What areas in need of improvement can you identify in your organization?

Session 3 Importance of Commitment by Top Management

Objectives: Demonstrate that management commitment is crucial.

Identify ways that management commitment can be increased.

References: Case Descriptions - Design and Implementation of Total Quality Management in a Civil Engineering Squadron, by 1st Lt Robert M. Wertz, 1989.
- Lessons Learned from the Implementation of Total Quality Management at the Naval Aviation Depot, North Island, CA, by Jeffery Allen Warmington, 1988.
- "FPL Wins the Deming Prize," by John Simmons, The Journal for Quality and Participation, March 1990, pp 74 - 76.
- "Motorola's Approach to Quality," by Ralph Barra, The Journal for Quality and Participation, Volume 12, Number 1, March 1989, pp 46 - 50.
- A Performance Management Framework for Civil Engineering, by Robert M. Gill, 1990.

Who is the top management for your organization?

How critical to your work is their support?

How does your management show what they support?

Questions for Case Evaluations:

How committed was top management in this case to the task the organization was working on? How did management show their level of commitment?

What would you suppose management was committed to?

How could management's commitment have been increased? Suggest some specific ways.

Who could have the possible impact on top management to increase their commitment? Who could convince them to more fully support the task of the organization?

Case 1. 2750 CES/DEM, Wright-Patterson AFB, OH

Early in fiscal year 1989, the Operations and Maintenance Branch of the 2750 Civil Engineering Squadron began a formal performance management effort. The squadron is a part of Air Force Logistics Command, which at the direction of its Commander, was implementing Total Quality Management principles command wide. The squadron had established a quality committee, comprised of many of the top officers and supervisors. This council was chaired by the Deputy Base Civil Engineer, and oversaw the quality efforts of the squadron. The Industrial Engineering Branch of the squadron had several enthusiastic and capable members who were eager to begin performance management efforts squadron wide.

The quality committee's job was to promote improvement within the organization and to determine when to form process action teams and which processes should be assigned for analysis. Committee members attended team meetings on occasion to show support and observe the activity. The committee designated a large conference room for team meetings. They further allowed team members time to meet, usually an hour per week. When a team arrived at proposed solutions for improvements, the committee was briefed by the team. The committee then took action on these recommendations.

As the effort progressed, and teams which were formed had been meeting for some time, the quality committee was found to provide inadequate direction to the process improvement efforts. One employee expressed a feeling that were it not for the AFLC commander's personally showing interest and involvement, the input from the Civil Engineering Squadron's top management would be almost nothing. It was only because the Industrial Engineering Branch advisors' efforts, covering up for lack of top squadron support, that any successful results were obtained.

Case 2. Naval Aviation Depot, North Island, CA.

In 1984, management at the Naval Aviation Depot decided to begin using performance management principles to improve their work processes. Initial training was slated for only the upper and middle management personnel. No training was provided for the workers and their immediate supervisors. The only training these employees received was that which was passed down by upper management.

The top management at the depot delegated the control of the performance management effort to a staff group, while the attention of top management was then diverted elsewhere. This sent the signal to the rest of the organization that the new improvement plans were not a top priority, and that top management was not supporting the performance management effort.

Process action teams were formed throughout the organization. In fact, the explosion in the number of new teams being formed grew too fast for upper management to support them effectively. Not enough planning or control had been established to direct the performance improvement momentum once it had been established. In spite of the organizational time and resources going into performance management, pressure was still being applied from users of the depot for all the existing quotas to be met. Top management was not supporting the teams by coordinating new schedules of delivery with these users, allowing the teams time to get established.

The employees' performance appraisals were not changed to reflect the new responsibilities of the process improvement teams. Soon the effectiveness of the effort began to decrease. Without support from top management for a change in emphasis for the organization, interest in working for improvements trailed off.

Case 3. Florida Power and Light

In 1981, Florida Power and Light began using quality teams to improve their delivery of electrical power to its customers. They achieved impressive results, being honored internationally by winning the Deming Prize, awarded to the organization using performance management techniques best. The transformation at Florida Power and Light was led all the way by its top management. The senior management team, led by the company's chairman, showed their commitment to new ways of managing by their behavior and their decisions.

The senior management team journeyed to Tokyo, Japan, to discuss performance improvement issues with a team of counselors there. Most any week of the year one of these Japanese counselors was likely to be found in Florida working with some unit of the organization. They worked to install a management system similar to what utility companies in Japan had found successful. The system emphasized getting ideas for improvements from the workers to management and the other way around, too.

Each senior manager is assigned objectives for improvement across several departments, to substitute cooperation for conflict. These managers made customer satisfaction their goal, and pushed this goal down through the levels of management in the organization.

Management decided to enter the competition for the Deming Prize as an incentive for their company to work for even greater improvements. The organization already had several years experience in performance management by this time. Their efforts accelerated as each member, already familiar with the performance management principles, multiplied their involvement toward this end. As a result, they accomplished in one year what it might have taken three or four to accomplish otherwise.

Senior management was committed throughout, going to classes, and refusing to delegate the reviews of progress, but rather performed these themselves. They had the patience not the abandon the plan when quick results did not materialize. They remained dedicated to providing the tremendous investment needed to train all employees.

Case 4. Motorola, Inc.

Motorola began their performance management effort in 1980. They have emphasized a top-down plan and a bottom-up dedication of employees to that plan. Their first step was to form a top-management council of quality executives. This council considered how to employ their most valuable resource for performance improvement, their people.

An ambitious training program was instituted to speed up the improvement process. This included not only analytical tools but quality awareness training as well. In addition, hiring criteria was changed to bring in more quality conscious people.

Motorola's twice-a-quarter policy and operating committee meetings focusing on performance management were chaired by no less than the Chief Executive Officer of the organization. Progress in improvement initiatives was reviewed, and reports made by each manager of a major unit regarding the quality efforts of that unit. Successes as well as failures are briefed. In addition, each business unit has its own individual performance meeting, again twice-a quarter, and again chaired by the CEO, to look in more detail at that unit's efforts.

Performance management planning is not limited to the top officers of the company. A program for participative management encourages every employee to contribute suggestions to teams, which then make recommendations for improvements. This fosters management support and communication. Managers share information, problems and opportunities with the employees, and ask for their ideas.

Management arranged for financial savings from the improvement efforts to be shared with the employees as part of an incentive plan. In addition, CEO awards are are issued to recognize large achievements.

Case 5. 2750 CES/DEE, Wright-Patterson AFB, OH

At the beginning of the 1990 fiscal year, the chief of the Engineering Branch of the 2750 Civil Engineering Squadron decided to use performance management in the organization to solve a persistent problem with the design review process. Performance management principles were chosen because of growing pressure from the Air Force Logistics Command to see organizations turn to these techniques, and to process action teams, to improve work processes. Support was provided by an individual in the Industrial Engineering Branch. Initial training was provided to all team members by this individual.

The Engineering Branch chief personally picked a team of individuals from the branch to participate in the team improvement effort. The chief decided to personally be a member of the team as well. The chief's office was used for meetings, and the team members were directed to take time out of their schedules to attend and contribute. The chief demonstrated by personal attendance, interest and involvement in the discussions of the process, that management commitment was present. Willingness to immediately implement the recommendations of the team further showed this commitment.

The chief's influence was used as needed to bring input or attendance from representatives of other organizations to meetings. This allowed the team to get at the root of the problems they encountered. Memos were drafted and meetings set up to communicate the results of the team's investigation. The team members seemed to put even more energy into evaluating and improving the design review process after seeing their chief take such an enthusiastic interest in the whole business.

When the team had reached their conclusions, an opportunity was arranged to brief the squadron quality committee on the results. This committee was made up of many of the senior officers and supervisors from the squadron. However, at the appointed time, most all the members of the committee were tied up elsewhere, and the presentation of results to management was of little impact. Nevertheless, the Engineering Branch chief continued to do all possible to see that the team's efforts were implemented.

How committed is your top management to a performance management framework?

How will this level of support impact your ability to use a performance management framework?

How can commitment by management be increased, if needed, or maintained if already adequate? Who can best convince your top management in this regard?

Session 4 Management Support and Cultural Change

Objectives: Identify the support roles of management in implementing and maintaining a performance management framework.

Define the concept of 'Cultural Change' and communicate the essential role of top management in creating the change in culture from the top down.

Management Support Roles

- Provide Example
  - Show interest
  - Get involved
    - Encourage individual applications
    - Apply the framework at the top
    - Make visible changes
- Provide Resources
  - Time
  - Space
  - Funds
  - Computer Resources
  - Support from consultants/DEI
- Coordinate Organization-Wide Efforts
  - Multi-discipline applications
  - Planning
  - Assure efforts are being made
  - Select processes for improvement

Reward Results

Recognition

Awards

Access to resources

Cultural Change

Culture

Your Organization's Culture - Man from Mars Perspective

Unneeded cultural attributes

Change

Formal Channels

Make new policy

Counter old culture

Informal Channels

Identify informal group leaders

Solicit their assistance

Conclusion and Summary

Session 5 Teamwork and Participation Concepts

Objectives: Establish the ability of a team to do more than the individual can in the subjective area of performance improvement planning.

Identify the types of groups: work area teams or multi-functional cross disciplinary teams. Discuss the effect of group size on group dynamics.

Present common problems plaguing groups. Teach team members to expect them, identify them, and correct them.

References: Group role definitions - Student's Guide, AFLC Facilitator Training, 1st Edition, October 1989, pp 120-121.

Conflict response strategies - Management: The Competitive Edge, by Edmund R. Gray and Larry R. Smeltzer, 1989, pp 412-413.

Individual Decision Making	Group Decision Making
Advantages	Advantages
Disadvantages	Disadvantages
Situational Factors	Situational Factors
Application Opportunities	Application Opportunities

When might a functional-area group be appropriate?

When might a cross-functional group be preferred?

How does group size affect group effectiveness?

Common Group Roles:

Task Related:

Initiator - Proposes tasks or goals; defines a group problem; suggests a procedure or idea for solving a problem

Seeker - Requests facts; seeks relevant information about group concern; asks for expressions of feelings; requests a statement or estimate; solicits expressions of value; seeks suggestions and ideas

Giver - Offers facts; provides relevant information about group concern; states a belief about a matter before the group, giving suggestions and ideas

Summarizer - Interprets ideas or suggestions; clears up confusion; defines terms; indicates alternatives and issues before the group; pulls together related ideas; restates suggestions after the group has discussed them, offering a decision or conclusion for the group to accept or reject; asks to see if group is nearing a decision

Maintenance Related:

Harmonizer - Attempts to reconcile disagreements; reduces tension; gets people to explore differences

Gate Keeper - Helps keep communication channels open; facilitates the participation of others; suggests procedures that permit sharing remarks

Encourager - Acts friendly, warm, and responsive to others; indicates acceptance of others' contributions

Compromiser - Offers a compromise; admits error; modifies own ideas in interest of group cohesion or growth

Standard Tester - Tests whether group is satisfied with its procedures; points out explicit or implicit norms which have been set to make them available for testing

Self Related:

Aggressor - Deflates the status of others; disapproves values, attacks the group problem; jokes aggressively; seeks recognition

Blocker - Tends to be negativistic and stubbornly resistant; disagrees and opposes beyond reason; attempts to bring back issue after group has rejected it; refuses to or ceases to participate

Dominator - Tries to assert authority in manipulating the group or certain members; flatters; asserts a superior right to attention

Playboy - Makes a display of his/her lack of ability and involvement in the group process; cynical or nonchalant; engages in horseplay

What are the merits and/or problems with each of the following ways of dealing with conflict?

Separate the conflicting parties

Impose rules or regulations to reduce the conflict

Bring the parties together to confront the issues and work out solutions

Session 6 Team Participation Exercise

Objectives: Allow the group members to work as a team. Give the individuals an opportunity to observe group interaction techniques and problems.

Discuss the dynamics of the group exercise.

Identify specific roles that people adopt in a group environment to facilitate performance.

Discover the role of a facilitator for the group.

How was this exercise similar to team decision making you might encounter on the job?

Role	Who?	How?
Initiator		
Seeker		
Giver		
Summarizer		

Role	Who?	How?
Harmonizer		
Gate Keeper		
Encourager		
Compromiser		
Standard Tester		
Aggressor		
Blocker		
Dominator		
Playboy		

What is a facilitator?

What actions might a facilitator take in a group decision making session?

How might a facilitator respond to each of these roles?

Initiator

Seeker

Giver

Summarizer

Harmonizer

Gate Keeper

Encourager

Compromiser

Standard Tester

Aggressor

Blocker

Dominator

Playboy

Session 7 Training Objectives and Pitfalls

Objectives: Establish the broad training goal of creating the cultural change needed for a successful program.

Define the more specific training goals of imparting tools for use in a performance management framework.

Introduce some of the most common problems and errors encountered in training programs.

What is cultural change?

How can training be used to begin this change?

Where should this training be accomplished?

How might training for use of specific performance management framework tools differ from the cultural change training?

Who would you recommend to lead this training? Where might this training be accomplished?

What problems might arise from training everyone right away?

What problems do you foresee from training people too extensively, or in too much detail for their needs?

What problems would be associated with having no training?

Session 8 Training Techniques and Strategies

Objectives: Identify which individuals in the Engineering Branch should receive training. Suggest what factors are pertinent to choosing these people.

Determine the most opportune time to provide various degrees of training. List important criteria in selecting this correct time in different situations.

List the essential ingredients to be included in the training curriculum. What situational factors might require revising these ingredients?

Session 9 Process Improvement

Objectives: Present the concepts associated with viewing organizational activity from a process perspective.

Understand the five principal features of process improvement plans.

Define cross-functional processes. Establish how to determine the input and output which flow between these producers and consumers.

Discuss ownership of processes. Show the importance of assigning responsibility for a process to a single individual.

Communicate the necessity of extending the process to its origin and conclusion. The greatest improvements for the least expense can often be made by thorough planning at the start of the process.

Reference: Process improvement plans - Total Quality Assurance Through Process Management, by Kenneth R. Jennings and others, 1989, 12-89.

Process Perspective

Definition

Repeatable

Universal

Relate to big picture

Building blocks of performance

Key to improvement

Process Improvement Plans

Definition

Suppliers	Activity Steps	Users
Input ------>	Transformation --->	Output

Simplification

Measurement

Control

Improvement

Identify Opportunities

Cause and Effect Planning

Action

Cross-functional Processes

Functional interdependence

Input

Output

Coordination

Process Ownership

Responsibility

Authority

Pride

Process Extension

Downstream

Upstream

Difficulties

Session 10 Process Flow Exercise

Objectives: To allow the group to identify a process in a multi-functional environment. The process interfaces will be determined, along with the input and output passed between these functions.

Session 11 Process Flow-charting

Objectives: To provide further experience in describing the underlying processes comprising the workplace.

Summarize the case.

Describe the processes evident in the case. List the steps which comprise these processes.

Which separate functional units are interfaced with in each process?

Who is the process owner? Over which steps in the process does the owner have personal authority?

What are elements of input and output evident in these processes?

How can defining the process in work situations assist in managing and improving the organization's performance?

Session 12 Definition of Performance & Customer Satisfaction

Objectives: List and define the seven components of performance. Discuss which are most appropriate for the Engineering Branch.

Understand the important role of customer or user satisfaction in improving performance. Identify who customers are of the Engineering Branch.

Reference: Planning and Measurement in Your Organization of the Future, by D. Scott Sink and Thomas C. Tuttle, 1989, pp171-186.

Performance Components

Effectiveness

Operational Definition -

The ratio of actual output to expected output. This is an output side component.

Possible applications -

How important is this as a component of performance?

Efficiency

Operational Definition -

The ratio of expected input to actual input. This is an input side component.

Possible applications -

How important is this as a component of performance?

Productivity

Operational Definition -

The ratio of output to input in the same units.

Possible applications -

How important is this as a component of performance?

Quality

Operational Definition -

The degree to which each step of the process, and the process as a whole, operates correctly.

Possible applications -

How important is this as a component of performance?

Innovation

Operational Definition -

An index of the creative process of changing to respond to new pressures, opportunities, and threats.

Possible applications -

How important is this as a component of performance?

Quality of Work Life

Operational Definition -

The reaction of the organization's personnel to the work environment, including factors such as pay, leadership, autonomy, involvement, and relationships.

Possible applications -

How important is this as a component of performance?

Budgetability

Operational Definition -

The relationship of budgets and goals with actual costs and accomplishments. This component is analogous to profitability in a private organization.

Possible applications -

How important is this as a component of performance?

Effectiveness and quality have been suggested as the two components most critical to the performance of a civil engineering organization. The other components depend on these two. Do you agree? Why might you think this to be the case?

Why is customer satisfaction important to the Engineering Branch?

Who are customers of the Engineering Branch?

How does the Engineering Branch serve each of these customers? How can they be better served?

PERFORMANCE COMPONENT DIAGRAM

```
              ---------------Budgetability------------
             |                                        |
             |-------Productivity--------             |
             |                           |            |
             |                           |            |
             |                           |            |
             |                           |            |
             |        Innovation         |            |
             |             |             |            |
USER ---- INPUT -- TRANSFORMATION -- OUTPUT ---      USER
NEED              |        |             |        SATISFACTION
                  |        |             |
                  |    Quality of        |
                  |     Work Life        |
                  |                      |
             Efficiency            Effectiveness

|_____________________Quality_____________________________|
```

Session 13 Application of Performance Components

Objectives: Apply the components of performance to the Engineering Branch environment. Suggest elements of performance which could be targeted for evaluation and improvement under a performance management framework.

Critically analyze one of the components of performance in its application in your organization.

What is a reasonable operational definition of this aspect of performance? How can it be measured or evaluated in your organization?

Suggest how this would allow managers to track performance and determine where improvement is possible. How would the improvement be recognized and reported?

Session 14 Implementation Details

Objectives: Outline the steps involved in a top-down implementation of a Performance Management Framework.

Illustrate the technique of using a pilot project to initiate the program.

Describe the importance of the facilitator to the operation of the team.

Describe how the following need to be addressed within the context of a performance management framework in order to promote successful improvement efforts.

Management direction

Strategic planning

Identification of principal processes comprising work

Selection of process as pilot project for first improvement effort

Selection of process for next team improvement effort

Management support

Assignment of members to the team

Training decisions

Selection of a facilitator to assist team

Team process definition

- Identify process steps
- Determine input and output
- Establish ownership
- Define interfaces with other functions

Team improvement efforts

- Identify problems
- Propose solutions
- Recommend actions
  - Who responsible
  - Schedule and milestones
  - How to measure for success

Management implementation

- Screen implementation actions
- Support implementation actions selected
- Reward efforts

Session 15 Implementation Exercise

Objectives: Provide a situation in which members can experience implementation of a performance management framework.

Discuss the lessons learned and how they might be applied to the implementation in the Engineering Branch Environment.

You are an engineering branch comprised of three sections, programming, design, and construction management. Due to the limited scope of this exercise, construction management will actually do the construction called for in the exercise. Your task is to program, design and build the items identified.

Part of this task requires costing of labor and materials to be used. Costs are:

Line Item	Cost
Whole sheets of construction paper	$10 / sheet
Unsharpened pencils	$ 5 / each
Tape	$ 1 / inch
Labor by builder	$ 2 / minute

Note that sheets of paper are charged as whole sheets, even if only a portion is used. The left over cannot be used on another project. Tape cannot be used in shorter than one inch pieces. Pencils cannot be broken.

What was the hardest part of the performance management framework exercise? Why?

What was the easiest part? Why?

What surprised you the most in working through a performance management framework?

Where do you see the greatest hindrance in doing this in your actual work? How can this hindrance be overcome?

What advantages and benefits do you think can be achieved by using a performance management framework in your organization?

Session 16 Measurement Exercise

Objectives: Understand the importance of measurement in evaluating and improving performance.

List reasons for measuring.

Define what to measure as the products which pass between steps in the process, from internal suppliers to internal customers.

Examine a method for analyzing variance between these steps.

References: Variance matrix - Total Quality Assurance Through Process Management, Kenneth R. Jennings and others, AFIT, 1989, pp 50-57.

Why is measurement important in evaluating and improving performance in your organization?

What uses can you see for measurement of your performance? How can it help managers understand, control and improve the work of the organization?

What is variance? What is the relationship of variance and measurement?

What are some measures of end product variance that might be used in the Engineering Branch?

Where is variance located within the work process?

How might variances at earlier steps in the process affect variances at later steps in the same process?

How can measuring and controlling variance at early steps in a complex process help control the end result?

How effective might improvement efforts be at this early point in the process?

Variance Matrix

The variance matrix analysis is a tool that helps identify the key variances which affect subsequent steps in the same process. The steps in a variance matrix analysis are listed below. The steps are then illustrated in an example on the following pages.

Step 1: Begin with the list of steps which make up the work process being evaluated. This includes every action needed to transform the input to output.

Step 2: Group sets of individual steps together into clusters. Each cluster should accomplish an identifiable change in the product in its transformation from input to output. This simplifies the analysis by concentrating a fewer number of main steps.

Step 3: Identify all possible sources of variance in each step. These cause the work to miss conforming to the standard or norm set for it.

Step 4: List variances chronologically in order of how they might occur in the process, matching each to the corresponding major step in the process.

Step 5: Identify upstream variances that impact or interfere with the control of downstream variances. A variance matrix is used for this purpose. Check each variance against all downstream variances listed beneath it. If a variance impedes control of a downstream variance, a mark is made.

Step 6: Locate key variances, those which impede control over several downstream variances. The degree of impact the variance has directly on cost and quality is also considered.

Step 7: Establish the factors which are important in controlling these key variances.

Example analysis using the variance matrix.

The process is the operation of a machine which assembles ham and cheese sandwiches.

Steps 1 and 2 in the Variance Matrix analysis are illustrated below. The detailed steps in the process are listed on the right, and are grouped into major steps as shown on the left.

Clustered Major Steps	Actual Steps
Prepare Bread	Replenish bread and mustard Fill machines Sort bread onto assembly tray
Add ham	Get container of ham Slice ham Position ham on bread
Add cheese	Get container of cheese Slice cheese Position cheese on ham
Insert lettuce	Cut lettuce Remove lumpy lettuce Position lettuce on cheese
Finish sandwich	Obtain bread for top Position bread on lettuce Cut sandwich
Package sandwich	Insert sandwich in machine Insert cardboard slip Prepare labels

Steps 3 and 4 in the Variance Matrix analysis are illustrated below. Individual variances were determined and then listed, clustered with the major step they correspond to, which are listed across the top. Refer, for example, to the major step "insert lettuce". The variances 14 and 15 can be seen listed under this step. Similarly, the variances for each step are listed beginning under the appropriate step, and in order of potential occurrence.

The Variance Matrix

```
Prepare    Add  Add       Insert    Finish    Package
Bread      Ham  Cheese    Lettuce   Sandwich  Sandwich
         :     :         :         :         :
1 Bread soggy
x2 Edges curled
xx3 Bread crooked
   4 Bottleneck
          5 Ham too warm
           6 Slices too thick
            7 Ham shredded
             8 Ham spoiled
 x            9 Ham crooked
               10 Cheese Moldy
                11 Cheese unwrapped
               x 12 Slices stuck together
 x                13 Cheese crooked
                         14 Lettuce lumpy
                          15 Lettuce wet
                                   16 Run out of top slices
                                    17 Slices wrong size
            x    x       x           18 Top not level
xx              x x      x           x19 Cut quality
                x        xx         x x      20 Package qual
xx         x  x x x      x          xxx      x21 Too big
x          x  x x x      xx         xxx      xx22 Not sealed
                                                23 Bad label

X  X      X  XXX         X                      X  Key Var.
```

Steps 5 and 6 in the Variance Matrix analysis are also illustrated above. For each variance, beginning with number 1, the list below that variance was scanned for any variances which might be affected by the preceding variance. Such relationships were marked with an "x". For example, note that variance 15 was determined to possibly affect variances 20 and 22, while variance 16 had no effect on subsequent variances. The key variances were then selected, and noted with a "X" at the bottom row. These were selected because of their multiplied effect on other variances or because on their own they were important enough to be called a key variance.

Step 7, not illustrated above, would then be to determine factors which control the behavior of the key variances.

Session 17 Cause and Effect of Measurement

Objectives: Understand the importance of measurement, and the components of an effective measurement system.

Reference: The cause and effect technique - DOD 5000.51-G, Total Quality Management, A Guide for Implementation, dated 15 Feb 89, p 51.

```
                Major Cause            Major Cause
           --------->|                      |<---------
             Minor   |                      |  Minor
            Causes   |                      |  Causes
           --------->|                      |<----------
                     |                      |
           ---------------------------------------> Result
                  |                     |
      --------->|                     |<------------
       Minor    |                     |    Minor
      Causes    |                     |   Causes
      --------->|                     |<------------
                |                     |
           Major Cause           Major Cause
```

What: Represents the relationship between an effect (problem or result) and its potential causes.

Why: The diagram is drawn to sort and relate the interactions among the factors affecting the result.

How:

1. Name the problem

2. Decide the major categories of causes. Major causes may include: data and information systems, dollars, environment, hardware and equipment, materials, measurements, methods, people, and training. Frequently, the four categories used are people, machines, methods, materials.

3. Brainstorm for more detailed causes.

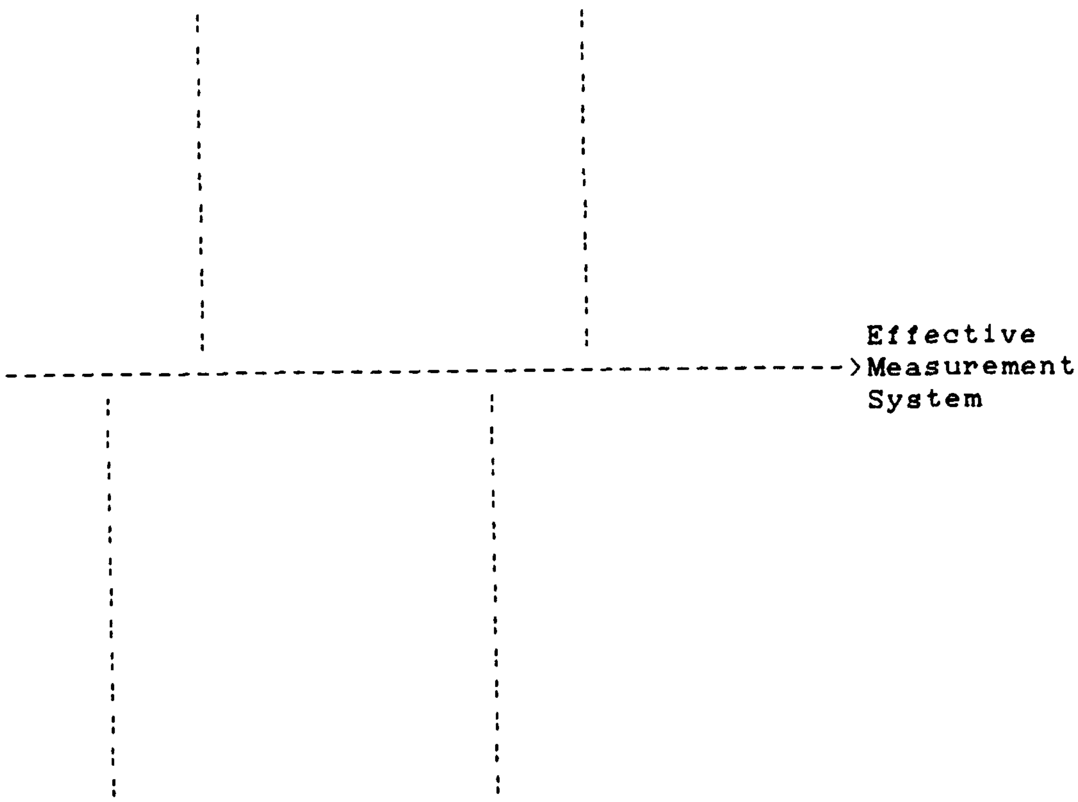
4. Eliminate causes that do not apply.

5. Discuss the remaining causes and decide which are most important.

6. Work on most important causes.

7. Eliminate or control causes.

Cause and Effect Analysis for an Effective Measurement System



Session 18 Objectives Matrix

Objectives: Demonstrate a technique to summarize non-related measures into a composite score.

Describe the distinction between product, process and surrogate measures, and the advantages of each.

Reference: Objectives matrix - Production Systems: Planning, Analysis, and Control, by James L. Riggs, 1987, pp 648-660.

Product Measures - Actual attributes of item ready for user

Process Measures - How product was attained

Surrogate Measures - Reflect actual attributes

What are the advantages and disadvantages of each?

What precautions are needed when using process and surrogate measures? How can you check their validity?

Objectives Matrix Worksheet

The following steps make up the objectives matrix analysis.

1. Establish Key Performance Areas (KPAs)
2. Determine Key Performance Indicators (KPIs)
3. Generate transformation curves
4. Assign relative weights
5. Compute performance index

1. Establish KPAs

KPAs are those performance components that are considered important to the organization's success. Usually these are determined by management or reflect the policies and objectives set by management. For example, the design branch may have the following as its KPAs.

Quality of the transformation process
Efficiency of manpower use
Effectiveness in the form of timeliness
Quality perceived by the user
Quality of the drawings and specifications
Productivity

2. Determine KPIs

Next a measurable characteristic must be found for each of these KPAs. These must be accurate, quantifiable, and representative of the performance component being measured. For example, KPIs for the KPAs above might be:

Efficiency	Direct Productive Manhours/ Total Manhours
Effectiveness	# Value Late Projects x Days Late
Quality of product	# Errors found by design chief at 100% complete
Quality to user	User Survey Response, scaled 1 - 10 Post-Design
Quality to user	User Survey Response, scaled 1 - 10 Post-Construction
Quality of process	Total # Change Orders/Total # Contracts
Productivity	# Value Designed/Manhours Used

3. Generate transformation curves

This is the principal distinctive of the objectives matrix analysis. The dissimilar performance indicator measures are converted into similar ten point index scores. These scores can then be combined as a weighted average into an overall performance index. The transformation curve is created individually for each KPI by first determining the anchor values, and then filling in the intermediate values. The anchor values include the zero and ten values on the index. Additionally, the value for three or five is fixed to further anchor the index. For example, the KPI for quality of process, the ratio of change orders, would be anchored as follows.

Index Value	Value of KPI measure
Zero	.5 (If change orders total half of the project cost, award no points)
Five	.12 (Anchor the midpoint at the historical mean of 12%)
Ten	0.0 (The best possible is no change orders, award full points)

Then fill in the rest of the scale. This can be done in any combination of linear or curved relationships as seems appropriate for the measure. Graph the relationship if desired to make the function more understandable.

Quality of Process

```
10 *
   :*
   : *
   :  *
   :    *
 5 :      *
   :        *
   :            *
   :                *
   :                     *
 0 :                            *
   ------------------------------
   0     .1    .2    .3    .4    .5
```

Index	KPI
10	0.0
9	.02
8	.04
7	.065
6	.09
5	.12
4	.16
3	.21
2	.28
1	.37
0	.5

Now, fill in the values for the rest of the KPI transformation curves. Anchor values have been provided. Graph the values if desired. Use any curved or linear relationships desired to fill in the values.

Index	Effic.	Effect.	Quality to user	Quality product	Prod.
10	>.75	0	10	0	2
9					
8					
7					
6					
5	.4	3200	5	5	1
4					
3					
2					
1					
0	0	>100000	0	10	<.5

4. Assign weights

The next step is to weight each of the KPIs so they can be combined into a weighted average. The sum of the weights must be one. Give more weight to the KPIs which are believed to be most important, and which are believed to be most valid. For instance, in the list above, the value of change orders is an important measure of how accurate the design is. It is also a highly valid measure because the cost of change orders can be accurately determined. This KPI should be weighted more heavily. On the other hand, the post-design user survey is not as important. The users often cannot judge accurately the quality of the design; they do not have the expertise. This KPI should not be weighted as heavily. You be the judge on the others. Fill in the weights below.

KPI	Weight
Total # Change Orders/Total # Contracts	_____
Direct Productive Manhours/ Total Manhours	_____
# Value Late Projects x Days Late	_____
User Survey Response, scaled 1 - 10 Post-Design	_____
User Survey Response, scaled 1 - 10 Post-Construction	_____
# Errors found by design chief at 100% complete	_____
# Value Designed/Manhours Used	_____
Sum	1.00

5. Compute Performance Index

Finally, the performance index can be calculated. This is done be measuring the performance for each KPI. The measure is converted into an integer score between zero and ten using the transformation curve. These scores are then averaged into the performance index using the weights. This procedure is made easy using a table, below.

KPA	Proc	Effic	Effec	Prodt	User1	User2	Prody	Score
Raw Value	.17	___	___	___	___	___	___	
Transformation Curves	0	>.75	0	10	10	0	2	10
	.02							9
	.04							8
	.065							7
	.09							6
	.12	.4	3200	5	5	5	1	5
	.16							4
	.21							3
	.28							2
	.37							1
	.5	0	>100000	0	0	10	<.5	0
Score	4	___	____	___	___	___	___	
Weight	___	___	____	___	___	___	___	
Weighted Score	___	___	____	___	___	___	___	
Performance Index								_____

Compute the performance index for the following measured KPIs.

quality of PROCess	.17
EFFICiency	.66
EFFECtiveness	5000
quality to USER1 post-design	6
quality to USER2 post-construction	3
quality of PRODucT	8
PRODuctivitY	1.25

Fill in your transformation curve values from earlier in the worksheet. Use the same values for USER1 and USER2. Fill in your weights for the KPIs in the appropriate place in the table. Enter each raw value on the appropriate line near the top of the table. Find the value on your transformation curve which most closely matches that value. Record this value on the line given. Multiply each score by its weight to obtain the weighted score. Sum these weighted scores and record the result at the bottom of the table as your performance index. This number should be between zero and ten. The closer to ten, the better overall performance for your organization.

Conclusion

This objectives matrix can be used with any measures appropriate for your organization. It allows you to quickly determine an overall ranking for your organization for the time period studied. This can allow management to track the organizations performance over time and make recommendations for improvements as needed.

What type was each measure, process, product or surrogate? Why?

How might a manager use such a combined index?

How would such an index be useful specifically for improvement?

Appendix C. Leader's Guide

This appendix contains the Leader's Guide for a three day training course in performance management. It follows the Plan of Instruction given in Appendix A. It is intended for use by the course leader/instructor to guide the discussion and activities planned to communicate the material. Each student in the course needs to be provided with a copy of the Student's Handbook in Appendix B. This handbook follows the same plan and provides the students with the outlines and information needed for the course to be successful.

An introduction and course schedule are given. Objectives are given for the course and each session. Detailed instructions are given for leading each session. These instructions are superimposed over a copy of the Student's Handbook. The format for this is explained in the Leader's Guide. The instructions are intended to allow a member of the base level Civil Engineering Squadron to lead the course, even if this individual has no previous experience in performance management or leading courses.

In preparing this handbook, material was adapted from other sources as appropriate. This material is referenced below:

Session 2	Case Descriptions (Hayes, 1990:19-24).
Session 3	Management Cases (Wertz, 1989; Warmington, 1988; Simmons, 1990:74-76; Barra, 1989:46-50)

Session 5	Group roles (HQ AFLC, 1989d:120-121). Conflict responses (Gray and Smeltzer, 1989:412-413).
Session 6	Participation exercise (HQ AFLC, 1989c:11-12 to 11-16).
Session 9	Process improvement plans (Jennings and others, 1989:12-89).
Session 12	Performance components (Sink and Tuttle, 1989:171-186).
Session 16	Variance matrix (Jennings and others, 1989:50-57).
Session 17	Cause and Effect (Department, 1989a:51).
Session 18	Objectives matrix (Riggs, 1987:648-660).

LEADER'S GUIDE

PERFORMANCE MANAGEMENT FRAMEWORK HANDBOOK

A handbook for the evaluation and
improvement of performance in the Engineering Branch of
Air Force Civil Engineering Squadrons

FOREWARD

This handbook is designed to assist Engineering Branch managers, engineers, and others who contribute to the preparation and execution of projects for real property construction, maintenance, and repair. These individuals are challenged with providing and maintaining quality facilities, allowing for Air Force organizations to perform their missions. Evaluation, management and improvement of the performance of Engineering Branch personnel is central to continuing to fulfill this mandate.

The goal of this handbook and the training which accompanies it is to acquaint Engineering Branch members with a framework for managing performance and to provide the tools needed to use this framework.

This leader's guide provides the guidance needed to allow a member of the Engineering Branch to lead a group of his/her peers through the training course included. This person need not be experienced in performance management or leading courses. The leader's guide provides adequate instructions to direct the leader through each session. A short amount of time spent becoming familiar with the lesson contents before each day's lessons will equip the leader for the role.

Performance Management Framework Objectives:

Foster a management perspective conducive to performance improvement

Create an organizational environment promoting performance improvement

Continually encourage the quest to discover and implement ways to improve performance

Course Objectives:

To equip civil engineering personnel to manage a performance management framework

To create momentum for performance improvement

To promote within civil engineering personnel a perspective for improvement

To provide the essential tools and techniques to establish and maintain a performance management framework

Explanation of Format:

The lesson plan outline is included in each lesson. The lesson headings and sub-headings, together with the recommended time for each, are underlined. These do not appear in the student handbook.

Notes for leading the lesson are preceded by "*****" and are indented. These notes do not appear in the student handbook.

All other text appears in the student handbook as shown.

General Instructions:

Prior to each day's training, the leader should read through the Leader's Guide for all the lessons in the day. Become sufficiently acquainted with the material and schedule of time allotted to move the class group through each lesson smoothly. Get a feel for how each lesson or subject transitions into the next. The leader should make notes in the guide to help keep organized.

The leader should use a clean paper flip pad and easel or overhead projector with plenty of clean transparency film and colored pens. The leader may either assign or ask for a group member to be the scribe for the group on the pad or overhead each session, or do it himself/herself. Such visible recording is an important team technique; make liberal use of it.

CLASS SCHEDULE

	First Day	Time	Page
Morning			
Topic: Introduction/Engineering Environment Distinctives			
Session 1	Introduction/ Distinctives	1 hour	185
Session 2	Benefits Available	1 hour	193
Topic: Role of Management			
Session 3	Management Commitment	1 hour	199
Session 4	Management Support	1 hour	207
	Lunch	1 hour	
Afternoon			
Topic: Employee Participation			
Session 5	Team Participation	1 hour	212
Session 6	Participation Exercise	2 hours	218

		Second Day	Time	Page
Morning				
	Topic: Training			
	Session 7	Training Objectives	1 hour	226
	Session 8	Training Techniques	1 hour	229
	Topic: Process Framework			
	Session 9	Process Improvement	1 hour	234
	Session 10	Process Flow Exercise	1 hour	241
		Lunch	1 hour	
Afternoon				
	Session 11	Process Flow-charting	1 hour	243
Topic: Target of Improvement				
	Session 12	Performance Definition	1 hour	245
	Session 13	Performance Components	1 hour	252

		Third Day		
Morning				
	Topic: Framework Implementation			
	Session 14	Implementation Details	1 hour	253
	Session 15	Implementation Exercise	3 hours	255
		Lunch	1 hour	
Afternoon				
	Topic: Measurement			
	Session 16	Measurement Exercise	1 hour	270
	Session 17	Cause and Effect Discussion	1 hour	276
	Session 18	Objectives Matrix	1 hour	280

Session 1 Introduction/Engineering Environment Distinctives

Objectives: Distinguish the Performance Management framework from other management fads and gimmicks which have come and gone.

Establish that this framework is one which civil engineering personnel design themselves to fit their own particular situations.

Lesson Plan: Introduction 5 min

*****Introduce self and briefly describe the course goals listed on the Forward page. Refer students to the Foreward page of their handbooks.

*****Read over the lesson objectives above with the group. Comment that attempts to improve management are nothing new in the Air Force, but that the framework for management presented here is different. Point out that several elements of this framework are likely to be things already being practiced in the management of this organization. Hopefully this course will expand on these and present some new useful ways to view management of performance.

Ice Breaker/ Stage Setter - Management Techniques 10-15 min

List management techniques which the Air Force or your organization have tried. How well have they worked?

*****Ask the group to list and evaluate other management techniques they have experienced. This question serves as an icebreaker for the group. Encourage interaction and contribution by all members. As a management technique is mentioned, ask if everyone is familiar with it or remembers it. If not, ask someone who does to explain it. Urge as many members will to to give their opinions of the techniques.

*****If the group gets stuck, prompt with "management by objectives," and "zero defects."

*****Ask the group to describe the management techniques they use now, and how well they work.

Components of a Successful Management System — 5-10 min

What are some essential aspects of a successful management framework?

*****Ask what aspects of these techniques have been worthwhile? What have you seen in these techniques of value?

*****Ask what the group believes should be in a successful management program.

Roadblocks to Successful Management Systems — 5 min

What are some aspects of management techniques which have not worked or have hampered the effectiveness of the technique?

*****Ask the group to identify the harmful aspects of management techniques they are familiar with. Start with techniques they have tried in the past. Move on to what they are using now.

*****Have the group define the destructive elements of the aspects identified.

Course Overview

Framework Objectives — 2 min

*****Present the course to the group. Where possible, point out where the course and/or performance management framework considers the essential components just listed by the group. Likewise emphasize where the course and/or framework avoids problems identified. Refer the group to the objectives page at the beginning of the handbook. Review the framework objectives listed there.

Course Objectives — 2 min

*****Review the course objectives listed on the same page.

__Engineering Environment__
__Distinctives__ __5 min__

*****Refer to the course schedule outlined at the front of the handbook. If desired, make overhead slides of the schedule to direct the group's attention to the leader. Note that this lesson and the one following dwell on the subject of the distinctives of the engineering environment. Present and discuss the information outlined on the slides attached to this lesson. The slides do not appear in the student handbook. The first slide is an introduction. Each of the following three slides have a question to be discussed. Use the overhead or easel pad to record the discussion. Note in closing this section that a performance management framework is not a 'cookbook' approach to performance improvement. It merely provides tools and perspectives useful for personnel to design their own plan.

__Role of Management__
__Employee Participation__
__Training__
__Process Framework__ __5 min__

*****Continue with the course schedule. Note that the remaining sessions today deal with the role and responsibilities of the personnel in the organization, both supervisors and employees. Note that tomorrow morning's sessions concentrate first on the extent and timing of training. Secondly the sessions key on the topic of understanding work through a process perspective, and the facility this perspective provides for improvement. Elaborate on these short descriptions. The leader will need to have become familiar with the individual session objectives to clearly explain these.

Target of Improvement
Framework Implementation
Measurement 5 min

*****Continue with the course schedule. Explain that tomorrow afternoon's sessions focus on the target of improvement. The important concept of user satisfaction will be considered. In addition, performance and its attributes will be discussed. Note that the next morning's sessions include an opportunity to work through an implementation exercise, which will bring together the points previously studied. Finally, the last afternoon will examine the important subject of measurement. The use of measurement in planning and evaluating improvement efforts will be considered. Again, the leader needs to be familiar with the individual lesson objectives and elaborate on these short descriptions.

Review Framework Objectives 1 min

*****Refer again to the objectives page. Review the framework objectives. Explain that as a result of this course, the members of the group will be prepared to use the framework.

*****The following four pages are slides to be used in discussing the Engineering Environment Distinctives above.

ENGINEERING ENVIRONMENT DISTINCTIVES

Project Orientation

Product of Ideas

People are Professionals

PROJECT ORIENTATION

Engineering projects are often one-time unique solutions to problems.

What difficulties does this present for managing a program to evaluate and improve performance?

PRODUCT IS IDEAS

Ideas are hard to quantify or evaluate.

What is the measure of a good project?

PEOPLE ARE PROFESSIONALS

Professionals are skeptical about a cookbook approach to performance improvement.

How can professionals be motivated to participate in a performance improvement plan?

Session 2 Potential Benefits from Performance Improvement

Objectives: Detail what benefits can be gained.

Demonstrate why improvement action is needed.

Understand benefits experienced in another workplace environment. Discuss differences in the civil engineering environment that may require adaptation or changes of approach from that used successfully in other situations.

Reference: The three case descriptions - "Three Views of TQM," by Glenn E. Hayes, Quality, Volume 29, April 1990, pp 19 - 24.

Lesson Plan: Introduction 2 min

*****Go over the session objectives above.

*****Explain that a good way to understand a performance management framework is to look at examples of its use.

Case Evaluations (3 cases) 23 min

*****Divide the group into three teams. Assign one of the cases on the following pages to each team. Instruct the teams to read, evaluate, and draw conclusions from the cases. The following questions are to be used in forming their evaluations. Inform them that each team is to present a 5-8 minute summary to the entire group. Tell them they have 20 minutes to make their preparation.

Questions for Case Evaluations:

What need did this organization identify which they sought to improve?

What action did they take to make improvements? What tools were used? What resources did they tap?

What benefits did they achieve? What improvements were realized?

How did this environment differ from the Air Force Engineering Branch environment you are in? In what ways was it similar?

Would the approach used work in your organization? Why or why not? What would need to be done differently to make improvements to some area of need in your branch? What could be done in a similar fashion?

Case 1. General Dynamics Space Systems Div., San Diego, CA

In 1985, senior managers at General Dynamics decided to use performance management principles to make their division prosper. A quality team was created to examine the organization. Work processes were found which were stuck in the trap of always doing things the same without questioning whether there was a better way. An atmosphere was created to encourage making changes without workers fearing reprisals.

The success of the performance improvement effort was attributed to a large degree to the support and direction provided by the top management. This group showed leadership, not just management, in making sure the employee improvement teams had all they needed to tackle nagging problems and bring misunderstood work processes to light.

Decisions were made about training, including who, what, when and how. Senior management sought training in how to provide a more favorable environment in which the workers could proceed with the performance improvement efforts. Management's commitment was shown further by making sure everyone else also received the training they needed in order to begin. Then management stood back and let teams of workers dive into evaluating and improving their work processes using performance management techniques.

As a result, the team's departments are now working together in better harmony. The material procurement, manufacturing, production and quality departments are functioning more as a single unit. They communicate more frequently and effectively. Costs have been reduced by as much as 30% as well. Improvements were made not only on the factory floor, but in the administrative processes. Prior to using performance management, their work to produce launch vehicles and to provide launch services was understood only from an engineering viewpoint. However, it took the new techniques and mindset of performance management to understand the work from a process viewpoint. This allowed the process to be charted and areas needing improvement to be exposed.

The improvements with the largest potential impacts were those focused not on production floor but on the administrative functions. Paperwork processes were found to have the longest cycle times. Shortening these turnaround times proved more important than the more direct production work processes.

Case 2. TRW Space & Defense Sector, Redondo Beach, CA

In mid-1989, TRW set goals for the sector into the new decade and chose performance management as a way to help reach these goals. One reason given was to meet their customers' expectations. A growing commitment to performance management principles exists in government, with whom much of their work is done. They did not want to fall behind their competitors, many of whom have begun such efforts. A second reason given was the bureaucratic nature of their business. Work processes needed to be improved to reduce the time and cost associated with this business bureaucracy. Wasted steps were to be cut out of the processes, promising savings of up to 30%. Worker motivation would be increased as individual responsibility was restored and waste eliminated.

Top management supported performance management by promoting the mindset needed to look for improvement, not just to get by. Involvement by every manager was expected. Each was to be receptive to improvement ideas and encourage the efforts of their people. Further support was provided in the form of resources needed to implement improvement teams and their ideas.

Performance management was formally begun when all senior managers attended training in how to lead the effort. Process action teams were formed and training provided for their members. These teams were directed to evaluate and propose improvements in the work processes of the organization. A goal of 30% cost reduction over several years was set. Each department was made responsible for a portion of that goal each year.

Accomplishments were made in both production oriented and idea oriented processes. Six processes that were initially attacked were: 1)travel expense reports; 2) Time card processing; 3) New hires and transfers; 4) Facilities requests; 5) Performance measurement systems; and 6) Administrative support requests. Each was marked by bureaucracy, and improvements were made by streamlining the processes and removing areas prone to mistakes.

The sector made sure that improvements in schedule, performance or cost were not made at the expense of quality. A focus was maintained of improving the work processes, and not just trying to dress up the products that result. A strong customer involvement was developed, making sure the work was in harmony with customer expectations.

Case 3. M/A-COM Government Systems Div., San Diego, CA

M/A-COM expanded its performance management efforts in March, 1989 as a result of observing improvements previously achieved in a limited use of the principles in its production area. Products were completed with less labor, fewer defects, and lower inspection costs. An additional motivation, as a government supplier, was the government's requirement that all its suppliers use such performance management principles.

Decision making authority was spread to lower levels in the organization. Workers were recognized for their contributions in performance management, setting the example that management was behind such efforts. Top management's active involvement in the improvement efforts was further demonstrated by including the topic and efforts in the executive council agenda for their monthly meetings. Initially, critical work processes to be evaluated and improved were defined by this council. Since then, other processes have been added as a result of suggestions from the employees.

Top management has been involved in activities related to performance management to show their support. Funds have been budgeted for training, which has been provided to all performance improvement teams. The efforts were given publicity through the organization's publications, where teams were credited for their accomplishments.

A consultant was hired to train the employees in the tools, mindset, and concepts of performance management. The plan was publicized to all personnel. Teams have already improved the data-handling process, and the employee suggestion policy is being evaluated. Perhaps one of the most significant accomplishments has been getting employees to work together in teams. Barriers are breaking down and communication improving as they understand their work processes and why others involved in them do the things they do. Not all improvements were large ones, but as long as they are aimed in the right direction they have been welcomed.

A critical element in the team problem solving was to first properly identify the process. This was done using the organization's mission statement and process flow-charting. The urge to jump the gun needed to be controlled. Only after adequate training and thorough process definition could successful efforts be pursued. Using the employees in an interactive, participative team setting has unlocked much potential for success.

Reports (5-8 min each) 20 min

*****Have the groups present their findings.

Application (Time permitting) 5 min
- Needs for improvement in
this organization

What areas in need of improvement can you identify in your organization?

*****Ask the question above. If the group is slow to respond, prod with "What obstacles prevent you from finishing all projects on time, in budget?" and "What prevents your being able to satisfy the users all the time in all projects?"

*****Comment when a list has been generated that these things may seem to be beyond their control, but that that is what a performance management framework seeks to assist in, is finding where control can be gained.

*****If time does not permit this discussion, ask the group members to consider the question during the day.

Session 3 Importance of Commitment by Top Management

Objectives: Demonstrate that management commitment is crucial.

Identify ways that management commitment can be increased.

References: Case Descriptions - Design and Implementation of Total Quality Management in a Civil Engineering Squadron, by 1st Lt Robert M. Wertz, 1989.
- Lessons Learned from the Implementation of Total Quality Management at the Naval Aviation Depot, North Island, CA, by Jeffery Allen Warmington, 1988.
- "FPL Wins the Deming Prize," by John Simmons, The Journal for Quality and Participation, March 1990, pp 74 - 76.
- "Motorola's Approach to Quality," by Ralph Barra, The Journal for Quality and Participation, Volume 12, Number 1, March 1989, pp 46 - 50.
- A Performance Management Framework for Civil Engineering, by Robert M. Gill, 1990.

Lesson Plan: Introduction 5 min

*****Review the session objectives listed above.

*****Ask the following questions.

Who is the top management for your organization?

How critical to your work is their support?

*****If the group has trouble with this one, ask "What are the things that get done: what management is pushing, or what you believe to be highest priority?"

How does your management show what things they support?

*****Ask "How do they treat things they do not hold to be important?"

Case Evaluations (5 cases) 20 min

*****Announce that cases will be evaluated to observe examples of management commitment. Divide the group into pairs. If there is an odd number of persons, have one group of three. Assign one case to each team. If there are less than 5 teams, do not use all the cases. If there are more than 5, assign some cases more than once. Instruct them to read, evaluate, and draw conclusions about the cases. Tell them to use the following questions as a guide. Inform them they will give 3-5 minute briefings of their evaluation to the entire group. Tell them they have 20 minutes to make their evaluations.

Questions for Case Evaluations:

How committed was top management in this case to the task the organization was working on? How did management show their level of commitment?

What would you suppose management was committed to?

How could management's commitment have been increased? Suggest some specific ways.

Who could have the possible impact on top management to increase their commitment? Who could convince them to more fully support the task of the organization?

Case 1. 2750 CES/DEM, Wright-Patterson AFB, OH

Early in fiscal year 1989, the Operations and Maintenance Branch of the 2750 Civil Engineering Squadron began a formal performance management effort. The squadron is a part of Air Force Logistics Command, which at the direction of its Commander, was implementing Total Quality Management principles command wide. The squadron had established a quality committee, comprised of many of the top officers and supervisors. This council was chaired by the Deputy Base Civil Engineer, and oversaw the quality efforts of the squadron. The Industrial Engineering Branch of the squadron had several enthusiastic and capable members who were eager to begin performance management efforts squadron wide.

The quality committee's job was to promote improvement within the organization and to determine when to form process action teams and which processes should be assigned for analysis. Committee members attended team meetings on occasion to show support and observe the activity. The committee designated a large conference room for team meetings. They further allowed team members time to meet, usually an hour per week. When a team arrived at proposed solutions for improvements, the committee was briefed by the team. The committee then took action on these recommendations.

As the effort progressed, and teams which were formed had been meeting for some time, the quality committee was found to provide inadequate direction to the process improvement efforts. One employee expressed a feeling that were it not for the AFLC commander's personally showing interest and involvement, the input from the Civil Engineering Squadron's top management would be almost nothing. It was only because the Industrial Engineering Branch advisors' efforts, covering up for lack of top squadron support, that any successful results were obtained.

Case 2. Naval Aviation Depot, North Island, CA.

In 1984, management at the Naval Aviation Depot decided to begin using performance management principles to improve their work processes. Initial training was slated for only the upper and middle management personnel. No training was provided for the workers and their immediate supervisors. The only training these employees received was that which was passed down by upper management.

The top management at the depot delegated the control of the performance management effort to a staff group, while the attention of top management was then diverted elsewhere. This sent the signal to the rest of the organization that the new improvement plans were not a top priority, and that top management was not supporting the performance management effort.

Process action teams were formed throughout the organization. In fact, the explosion in the number of new teams being formed grew too fast for upper management to support them effectively. Not enough planning or control had been established to direct the performance improvement momentum once it had been established. In spite of the organizational time and resources going into performance management, pressure was still being applied from users of the depot for all the existing quotas to be met. Top management was not supporting the teams by coordinating new schedules of delivery with these users, allowing the teams time to get established.

The employees' performance appraisals were not changed to reflect the new responsibilities of the process improvement teams. Soon the effectiveness of the effort began to decrease. Without support from top management for a change in emphasis for the organization, interest in working for improvements trailed off.

Case 3. Florida Power and Light

In 1981, Florida Power and Light began using quality teams to improve their delivery of electrical power to its customers. They achieved impressive results, being honored internationally by winning the Deming Prize, awarded to the organization using performance management techniques best. The transformation at Florida Power and Light was led all the way by its top management. The senior management team, led by the company's chairman, showed their commitment to new ways of managing by their behavior and their decisions.

The senior management team journeyed to Tokyo, Japan, to discuss performance improvement issues with a team of counselors there. Most any week of the year one of these Japanese counselors was likely to be found in Florida working with some unit of the organization. They worked to install a management system similar to what utility companies in Japan had found successful. The system emphasized getting ideas for improvements from the workers to management and the other way around, too.

Each senior manager is assigned objectives for improvement across several departments, to substitute cooperation for conflict. These managers made customer satisfaction their goal, and pushed this goal down through the levels of management in the organization.

Management decided to enter the competition for the Deming Prize as an incentive for their company to work for even greater improvements. The organization already had several years experience in performance management by this time. Their efforts accelerated as each member, already familiar with the performance management principles, multiplied their involvement toward this end. As a result, they accomplished in one year what it might have taken three or four to accomplish otherwise.

Senior management was committed throughout, going to classes, and refusing to delegate the reviews of progress, but rather performed these themselves. They had the patience not the abandon the plan when quick results did not materialize. They remained dedicated to providing the tremendous investment needed to train all employees.

Case 4. Motorola, Inc.

Motorola began their performance management effort in 1980. They have emphasized a top-down plan and a bottom-up dedication of employees to that plan. Their first step was to form a top-management council of quality executives. This council considered how to employ their most valuable resource for performance improvement, their people.

An ambitious training program was instituted to speed up the improvement process. This included not only analytical tools but quality awareness training as well. In addition, hiring criteria was changed to bring in more quality conscious people.

Motorola's twice-a-quarter policy and operating committee meetings focusing on performance management were chaired by no less than the Chief Executive Officer of the organization. Progress in improvement initiatives was reviewed, and reports made by each manager of a major unit regarding the quality efforts of that unit. Successes as well as failures are briefed. In addition, each business unit has its own individual performance meeting, again twice-a quarter, and again chaired by the CEO, to look in more detail at that unit's efforts.

Performance management planning is not limited to the top officers of the company. A program for participative management encourages every employee to contribute suggestions to teams, which then make recommendations for improvements. This fosters management support and communication. Managers share information, problems and opportunities with the employees, and ask for their ideas.

Management arranged for financial savings from the improvement efforts to be shared with the employees as part of an incentive plan. In addition, CEO awards are are issued to recognize large achievements.

Case 5. 2750 CES/DEE, Wright-Patterson AFB, OH

At the beginning of the 1990 fiscal year, the chief of the Engineering Branch of the 2750 Civil Engineering Squadron decided to use performance management in the organization to solve a persistent problem with the design review process. Performance management principles were chosen because of growing pressure from the Air Force Logistics Command to see organizations turn to these techniques, and to process action teams, to improve work processes. Support was provided by an individual in the Industrial Engineering Branch. Initial training was provided to all team members by this individual.

The Engineering Branch chief personally picked a team of individuals from the branch to participate in the team improvement effort. The chief decided to personally be a member of the team as well. The chief's office was used for meetings, and the team members were directed to take time out of their schedules to attend and contribute. The chief demonstrated by personal attendance, interest and involvement in the discussions of the process, that management commitment was present. Willingness to immediately implement the recommendations of the team further showed this commitment.

The chief's influence was used as needed to bring input or attendance from representatives of other organizations to meetings. This allowed the team to get at the root of the problems they encountered. Memos were drafted and meetings set up to communicate the results of the team's investigation. The team members seemed to put even more energy into evaluating and improving the design review process after seeing their chief take such an enthusiastic interest in the whole business.

When the team had reached their conclusions, an opportunity was arranged to brief the squadron quality committee on the results. This committee was made up of many of the senior officers and supervisors from the squadron. However, at the appointed time, most all the members of the committee were tied up elsewhere, and the presentation of results to management was of little impact. Nevertheless, the Engineering Branch chief continued to do all possible to see that the team's efforts were implemented.

Reports (3-5 min each) 20 min

*****Have groups present their findings.

Application 5 min
- Commitment of top management
for this organization

*****Have the group discuss the following questions.

How committed is your top management to a performance management framework?

How will this level of support impact your ability to use a performance management framework?

How can commitment by management be increased, if needed, or maintained if already adequate? Who can best convince your top management in this regard?

Session 4 Management Support and Cultural Change

Objectives: Identify the support roles of management in implementing and maintaining a Performance Management Framework.

Define the concept of 'Cultural Change' and communicate the essential role of top management in creating the change in culture from the top down.

Lesson Plan: Review and Introduction 3 min

*****Comment that last hour we looked at the importance of management support and ways to increase that support. Explain that this hour we will build on this basis. Review the session objectives above.

*****Work through the following structured discussion with the group. Suggested times for each sub-heading are underlined. Ask for practical applications, insights and ideas of ways each point is important. Make overhead slides out of the student's handbook or copy the outline onto an easel pad if desired. Pause at the end of each major heading to allow response/reaction.

Management Support Roles

Provide Example 5 min

Show interest

*****Genuine interest, not just lip service.

Get involved

Encourage individual applications

*****Management by walking around is a management style where the boss goes to the workplace and, without meddling, sees what his/her people are doing. Would this help?

Apply the framework at the top

*****Like the White House not having a recycling program while preaching environmental issues, often it is not what we say, but what we do.

Make visible changes

*****Show it is not business as usual.

Provide Resources 3 min

Time

*****People need to be free for training and evaluation of performance.

Space

*****For meetings.

Funds

*****To implement improvements needed.

Computer Resources

*****For tracking performance.

Support from consultants/DEI

*****For guidance and help in using the tools of a performance management framework.

Coordinate Organization-Wide Efforts 5 min

Multi-discipline applications

*****Many improvement efforts will cut across functional and section or branch lines. Upper management coordination is needed to assure cooperation.

Planning

*****Lack of resources may constrain applications. Planning is needed to give the most promising projects first cut at the resources.

Assure efforts are being made

*****Upper management can track the progress of the improvement efforts across the organization. If one area is not making progress, attention can be given to see if additional training or resources are needed.

Select processes for improvement efforts

*****Management must determine which work processes to focus on first, and select team members to work each process.

Reward Results 2 min

Recognition

*****Letters, presentations, or a bulletin board specifically set up to bring attention to outstanding performance management framework achievements.

Awards

*****Any form of individual incentive awards.

Access to resources

*****Reward high achievement sections with some kind of desirable improvement project, or new system of some type they can use.

Cultural Change

Culture

*****Define culture as the actual guidelines which an organization follows in doing its work. Remark that this will become clearer through an exercise.

Your Organization's Culture - Man from Mars Perspective 20 min

*****If a man from Mars were to invade this organization, and observe it, what would he conclude is the actual rules of play that are followed. List as many as come to mind. This is not the official organizational goals or charter. What would this alien outsider conclude is the real motivators of the work place.

*****If stuck, prompt with "the squeaky wheel gets the grease," "put out fires," "micro-management from the top," "short term results."

*****Note that this is the culture of this organization.

Unneeded cultural attributes

*****Have the group identify any of the above list which are not productive, or which could be changed to be more productive. Ask how this would help.

Change 3 min

*****Note that in order to create a cultural change, one must first understand the present culture. Only then can one take control of the culture, and alter aspects to a more favorable environment for improvement. Comment that there are two channels through which the cultural changes must be made.

Formal Channels 3 min

*****This is the official management making and communicating decisions through the official chain of command.

Make new policy

Counter old culture

*****Show that the old cultural anchors are no longer attached, that now you are marching to the beat of a different drummer.

Informal Channels 4 min

*****The informal group structure can often carry more influence with individuals than the official chain of command. This influence is communicated through group norms and approval.

Identify informal group leaders

*****Those people who are respected and whom people take their cues from.

Solicit their assistance

*****If brought into your camp from the beginning, these people can be powerful allies. If alienated or excluded from the beginning, these people can block everything you try to do.

Conclusion and Summary 2 min

*****Summarize the management roles.

Provide Example
Provide Resources
Coordinate Organization-Wide Efforts
Reward Results

*****Summarize Cultural Change.

Know your organizations culture. Harness both formal and informal channels to change this culture to better support the performance improvement effort.

Session 5 Teamwork and Participation Concepts

Objectives: Establish the ability of a team to do more than the individual can in the subjective area of performance improvement planning.

Identify the types of groups: work area teams or multi-functional cross disciplinary teams. Discuss the effect of group size on group dynamics.

Present common problems plaguing groups. Teach team members to expect them, identify them, and correct them.

References: Group role definitions - Student's Guide, AFLC Facilitator Training, 1st Edition, October 1989, pp 120-121.

Conflict response strategies - Management: The Competitive Edge, by Edmund R. Gray and Larry R. Smeltzer, 1989, pp 412-413.

Lesson Plan: Introduction 3 min

*****Remind the group that this morning, elements of the engineering environment which make it distinctive for performance management were presented. Management's important role in initiating and sustaining the improvement effort were discussed. This afternoon, the topic will shift to the part employees and middle managers play in performance management framework.

*****Review the session objectives above.

Group Decision Making

Compared to Individual 12 min

*****Instruct the group to identify and list some advantages and disadvantages associated with individual and group decision making.

*****When adequate advantages and disadvantages have been listed, ask for situational factors which would favor one approach over the other. Many of these will be suggested from the advantages and disadvantages. Some examples are: speed, accuracy, acceptance of decision by the organization, risk taking, and innovation.

*****When some situational factors have been listed, ask for specific application opportunities in their organization. What are some decision opportunities where factors favor one or the other, and why?

*****If the group is stuck here, suggest some decision opportunities and ask which approach would be favored and why? Examples are: determining which projects should be designed by A-E or in-house, deciding architectural treatment for a building, selecting performance period for a project, determining if a contractor's question is covered by the specifications.

*****Finally, ask which method would be appropriate for performance improvement planning. Evaluating your organization for areas to be improved and planning those improvements are decisions to be made. What advantages and disadvantages for team or individual decision making can the group suggest. Summarize after discussion that the complexity and importance of the decisions indicates a team approach shows most promise.

Individual Decision Making	Group Decision Making
Advantages	Advantages
Disadvantages	Disadvantages
Situational Factors	Situational Factors
Application Opportunities	Application Opportunities

<u>Group Structure</u>

<u>Composition</u> <u>8 min</u>

*****Explain that a functional-area group is one composed from members of the same job shop or work area. The members are the workers and their immediate supervisor.

When might a functional-area group be appropriate?

*****Suggest to the group that a functional-area group should include everyone the the shop or area. Ask the group why this might be important.

*****Ask the group what type of goals such a group would have.

*****Ask what length of time would they meet over. Relate this to the group goals.

*****Explain that a cross-functional group, by contrast, is made up of representatives of each function that is involved in the task concerned.

When might a cross-functional group be preferred?

*****Ask the group to describe the type of individuals who should make up this group. Would they be the most capable from each section or the least? Why might you want the best people?

*****Note that these type groups are most often formed to address specific problems in the way things are done. Ask what length of time they might continue meeting for.

*****Ask the group to contrast the two groups, noting differences in their style and purpose.

<u>Size</u> <u>7 min</u>

How does group size affect group effectiveness?

*****Comment that another important aspect of group decision making is the group size. Ask the group to discuss the impact of having too large a group. Too small.

*****Ask the group what they think of the size of this class for group decision making.

*****Note that organizational behaviorists suggest 6 to 12 as a good range. Ask if any one can think of a classic example of group decision making with groups this size. Prompt with jury trial only if needed. Ask why it is critical in that situation to get a good decision. Relate this to the importance in your organization to get good improvement effort decisions.

Group Roles 12 min

Common Group Roles:

*****Read through the following group role descriptions.

Task Related:

Initiator - Proposes tasks or goals; defines a group problem; suggests a procedure or idea for solving a problem

Seeker - Requests facts; seeks relevant information about group concern; asks for expressions of feelings; requests a statement or estimate; solicits expressions of value; seeks suggestions and ideas

Giver - Offers facts; provides relevant information about group concern; states a belief about a matter before the group, giving suggestions and ideas

Summarizer - Interprets ideas or suggestions; clears up confusion; defines terms; indicates alternatives and issues before the group; pulls together related ideas; restates suggestions after the group has discussed them, offering a decision or conclusion for the group to accept or reject; asks to see if group is nearing a decision

Maintenance Related:

Harmonizer - Attempts to reconcile disagreements; reduces tension; gets people to explore differences

Gate Keeper - Helps keep communication channels open; facilitates the participation of others; suggests procedures that permit sharing remarks

Encourager - Acts friendly, warm, and responsive to others; indicates acceptance of others' contributions

Compromiser - Offers a compromise; admits error; modifies own ideas in interest of group cohesion or growth

Standard Tester - Tests whether group is satisfied with its procedures; points out explicit or implicit norms which have been set to make them available for testing

Self Related:

Aggressor - Deflates the status of others; disapproves values, attacks the group problem; jokes aggressively; seeks recognition

Blocker - Tends to be negative and stubbornly resistant; disagrees and opposes beyond reason; attempts to bring back issue after group has rejected it; refuses to or ceases to participate

Dominator - Tries to assert authority in manipulating the group or certain members; flatters; asserts a superior right to attention

Playboy - Makes a display of his/her lack of ability and involvement in the group process; cynical or nonchalant; engages in horseplay

*****Ask the group if they think all these roles are useful in group dynamics. Why or why not?

*****Note that these roles are not necessarily exclusive to one person, nor are persons limited to only one role. People may adopt various roles as the need arises. However, some roles begin to be expected of the certain people

<u>Conflict</u> <u>8 min</u>

*****Lead the group through the following discussion.

What are the merits and/or problems with each of the following ways of dealing with conflict?

Separate the conflicting parties

Impose rules or regulations to reduce the conflict

Bring the parties together to confront the issues and work out solutions

Session 6 Team Participation Exercise

Objectives: Allow the group members to work as a team. Give the individuals an opportunity to observe group interaction techniques and problems.

Discuss the dynamics of the group exercise.

Identify specific roles that people adopt in a group environment to facilitate performance.

Discover the role of a facilitator for the group.

Reference: Participation Excercise - Instructor Guide, AFLC Facilitator Training, 1st Edition, October 1989, 11-12 to 11-16.

Lesson Plan: Participation Exercise 50 min

*****Have the members of the group put away their handbooks and other materials for this group exercise. Divide the group into at least two teams, preferably with six students in each team. If there are less than six on a team some members will need to receive more than one clue card described below.

*****Say: Each member of your team will receive written bits of information. These are not to be shown to others. What will be required of you, and how to go about it, will become clear to you as you share information with each other through verbal communication only. When a team feels that the required tasks have been completed, call the judge (leader) to check your results. If your tasks have been only partially completed, or if you have done more than required, the judge will consider the tasks as being totally incomplete. The judge will not share with you what, if anything, has been completed correctly.

*****Continue: The following rules will be observed throughout this activity:

a. From the moment the team begins work, members may speak only to other members of their team.
b. You may not show others the content of your written bits of information.
c. You may not write anything.
d. You must obey the judge's instructions.

You will have the rest of this hour to finish the task.

*****Separate the teams as much as possible. Pass out the following bits of information. Ask for any questions. Have them begin.

*****When a team presents their solution, compare it to the answer. If not entirely correct, only say 'incorrect'. If correct, inform the team when to be back for the next session.

FARMERS BITS OF INFORMATION SHEET (A)

The dog's owner lives next door to the house with the plum orchard
Hull raises albino rats
The farmer who lives next to Pavlov drives a station wagon
Only one of the village houses is located on the east side

FARMERS BITS OF INFORMATION SHEET (B)

Pavlov's neighbor raises chimpanzees
Skinner lives next to the red brick house
The farmer who raises dogs also grows cherries
One of your group's tasks is to decide who drives a truck
The houses of the village are standing in a semicircle, beside each other

FARMERS BITS OF INFORMATION SHEET (C)

Kohler grows pears
There is a limousine in the garage of the ranch house
Each farmer raises a different kind of animal
Farmer Thorndike lives next to farmer Skinner
A motorcyle stands in the back yard of the log cabin

FARMERS BITS OF INFORMATION SHEET (D)

The person who raises cats lives next door, to the east, of the house with almond trees
Your group has less than three tasks
Every week, boxes of dog food are placed at the gate of the log cabin
Only one of the village houses is located on the West side
Each of the five farmers living in the village drives a different kind of vehicle

FARMERS BITS OF INFORMATION SHEET (E)

The log cabin is in the most northern position of the village
Each farmer grows a different kind of fruit
The ranch house stands next to the cottage
Farmer Thorndike drives a sports car
Farmer Skinner raises pigeons

FARMERS BITS OF INFORMATION SHEET (F)

Only Skinner lives at the west end of the village
There are albino rats in the yard of the ranch house
One of the groups tasks is to decide who grows the apples
Pavlov lives in the log cabin
Each farmer lives in a different type of house
Thorndike lives between the bungalow and log cabin

Answer:

Skinner drives a truck

Hull raises apples

Anything else in the solution is incorrect.

Break — 10 min

Evaluation

Review Objectives — 2 min

*****Review the objectives at the beginning of this session

Importance of Individual's Contribution — 5 min

How was this exercise similar to team decision making you might encounter on the job?

*****Discuss this question.

*****Note that in the excercise each individual had essential information. What if one person's input had been left out?

*****Ask whose responsibility it is to see that everyone gives input.

Understanding and Identifying Roles 28 min

*****Go through the list of roles and discuss who in each group was observed to behave similarly to that role. List specific things they did.

Role	Who?	How?
Initiator		
Seeker		
Giver		
Summarizer		
Harmonizer		
Gate Keeper		
Encourager		
Compromiser		
Standard Tester		

Role	Who?	How?
Aggressor		
Blocker		
Dominator		
Playboy		

Facilitators

Introduction 5 min

What is a facilitator?

*****Define a facilitator as an asset to the group assigned responsibility for group dynamics, and for keeping the group on track and functioning effectively.

*****Ask the following question.

What actions might a facilitator take in a group decision making session?

Response to Roles 10 min

How might a facilitator respond to each of these roles?

*****Discuss how a facilitator might respond to these roles people adopt in a group setting. Encourage the group to look back at the individual members of their team in the excercise, and think how a facilitator might respond to improve the group effectiveness.

Initiator

Seeker

Giver

Summarizer

Harmonizer

Gate Keeper

Encourager

Compromiser

Standard Tester

Aggressor

Blocker

Dominator

Playboy

Session 7 Training Objectives and Pitfalls

Objectives: Establish the broad training goal of creating the cultural change needed for a successful program.

Define the more specific training goals of imparting tools for use in a performance management framework.

Introduce some of the most common problems and errors encountered in training programs.

<u>Lesson Plan:</u> <u>Introduction</u> <u>10 min</u>

*****Ask what kinds of training individuals have been through before in association with their jobs. List some.

*****Ask how useful the training was. In what ways was it useful? What parts were not worth the effort?

*****Ask what are some elements training should include. Where should the line be drawn where further training is not worth the effort?

*****Review the session objectives above.

<u>Cultural Change Training</u> <u>15 min</u>

What is cultural change?

*****Note that this subject was mentioned in the morning's lessons about management's role. Ask the group to review the meaning of cultural change. Ask how it is accomplished. Ask why is it necessary.

How can training be used to begin this change?

*****Ask if a Man from Mars exercise is valuable? Why or why not?

*****Ask if having the informal leaders give testimonials would be effective. Why or why not?

*****Would having the squadron commander come and challenge the trainees work? Why or why not?

*****Would having someone whom everyone would think to be the last to support such an improvement effort, in fact to resist it, come and give support be a help? Why or why not?

*****Ask for other suggestions.

*****Ask where this training should be accomplished, and by whom.

Where should this training be accomplished?

Specific Tools Training 10 min

*****Comment that in addition to training for cultural change objectives, there are particular tools and specific techniques to be understood by various individuals involved in a performance management framework, such as measurement methods, evaluation techniques. Ask:

How might training for use of specific performance management framework tools differ from the cultural change training?

*****Ask what the objectives of this training would be. How detailed does this training need to be compared to the cultural change training.

*****Ask:

Who would you recommend to lead this training? Where might this training be accomplished?

Problems   15 min

*****Inform the group that now we will turn our attention to some common problems that arise in training programs. The first is going "training happy" and steamrolling everyone through training right away. Ask:

What problems might arise from training everyone right away?

*****Do you see any advantages to such a plan. Do you think the benefits outweigh the costs. If they seem stuck, ask them to think about training they have been through, and if any conclusions can be drawn.

*****Note that a related symptom is seeing the interest become nothing more than a slogan program. People need to be able to see real changes and commitment along with the talk.

What problems do you foresee from training people too extensively, or in too much detail for their needs?

*****Describe another problem as the shotgun approach to training. Give them everything, whether they need it or not. Ask what harm they see in this. Is it possible to lose sight of the forest for the trees?

*****Ask if the group sees any advantages in this approach. Do they think the benefits outweigh the costs?

What problems would be associated with having no training?

*****Comment that another problem is just the opposite of what we have been discussing, and that is the sink or swim method. No training is given. Ask what harm the group can see in this.

*****Ask for any benefits the group can think of. Ask if the benefits outweigh the costs.

*****Summarize and wrap up.

Session 8 Training Techniques and Strategies

Objectives: Identify which individuals in the Engineering Branch should receive training. Suggest what factors are pertinent to choosing these people.

Determine the most opportune time to provide various degrees of training. List important criteria in selecting this correct time in different situations.

List the essential ingredients to be included in the training curriculum. What situational factors might require revising these ingredients?

Lesson Plan: Introduction 3 min

*****Remind the group that last hour they looked at some of the objectives and problems of training. Inform them that this hour they will have an opportunity to look in more detail at overcoming these problems by examining who, what, and when to train.

*****Review the *lesson objectives* above.

Team Project 32 min

*****Divide the group into three teams. Give a list of questions to be discussed to a representative from each team. Instruct them to generate a training plan or answers to the questions given. Note that each team will have a five minute opportunity to brief their conclusions to the group. Tell them they have 30 minutes to prepare.

*****Following are the lists of questions for each team.

Team 1: Topic - Who to train?

Assignment - Develop a list of whom within the organization you would train. What type of training (cultural change, specific tools, other) should they receive? It is not necessary to detail the content of the training, just identify the overall theme proposed.

Questions to consider -

What are the criteria you use to select the people for each type of training?

Where there are several individuals within the same work area having the same job description, what factors affect who you pick for training? Or do you train them all alike? Why?

Who would you have provide the training? Why?

What specific objectives would you set for each type of training?

Team 2: Topic - When to train

Assignment - Develop guidelines for when you would provide training within your organization for differing types of training (cultural change, specific tools, other).

Questions to consider -

Do you want to have all the training an individual receives provided at one time, or give different levels of training at different times? Why?

What kind of schedule of getting people each type of training would you follow?

What situational factors would affect your training schedule guidelines? What are your criteria for deciding when to train?

How often, if ever, would you have refresher courses?

What objectives would you set for each type of training?

Team 3: Topic - What to train

Assignment - Develop the components that you would put into the contents of each type (cultural change, specific tools, other) of training course?

Questions to consider -

What things are essential for the trainees to come away with?

Should the content be the same for everyone? Why or why not?

What important ingredients would need to be included in the training?

What objectives would you set for each type of training?

Presentations 15 min

*****Provide each team five minutes to present their plan and answer questions.

Session 9 Process Improvement

Objectives: Present the concepts associated with viewing organizational activity from a process perspective.

Understand the five principal features of process improvement plans.

Define cross-functional processes. Establish how to determine the input and output which flow between these producers and consumers.

Discuss ownership of processes. Show the importance of assigning responsibility for a process to a single individual.

Communicate the necessity of extending the process to its origin and conclusion. The greatest improvements for the least expense can often be made by thorough planning at the start of the process.

Reference: Process improvement plans - Total Quality Assurance Through Process Management, by Kenneth R. Jennings and others, 1989, 12-89.

Lesson Plan: Introduction 3 min

*****Review the lesson objectives above.

Process Perspective 7 min

Definition

*****Define process as all activities which are performed to accomplish a recurring organizational objective.

Repeatable

*****Note that to qualify as a process the procedure must be repeatable, something that the organization does many times.

Universal

*****State that all workplace activities fall into some process. Ask the group if they can think of any things they do which do not fall within a process. If they suggest work on individual unique projects, reply that even though the project is unlike others, the procedure followed to define the project and solve it is a repeatable process.

Relate to big picture

*****Note that viewing the individual tasks each worker does as a part of a larger process helps create the process perspective.

Building blocks of performance

*****Ask the group to what degree organizational performance depends on how well each of their processes are accomplished? If they do well on each of the processes, will they necessarily do well overall? Why or why not?

Key to improvement

*****Ask the group to describe the usefulness of a process perspective on the work they do with regard to identifying opportunities for improvement.

*****Note that many opportunities for improvement exist at the communication interfaces between steps in these processes.

Process Improvement Plans 15 min

Definition

*****Explain that the first step in process improvement is understanding the structure and steps of the process. Explain the diagram below by pointing out the the process begins at the point some external supplier provides input. It continues until some output is provided to a user. Along the way are all the individual steps of the process which must be accomplished to transform the input to output.

*****Ask the group if this kind of model would apply to the processes that make up their work. Do they have suppliers and users or customers? Why or why not?

```
Suppliers        Activity Steps        Users

 Input ------> Transformation ---> Output
```

*****Ask the group how they would go about identifying the activity steps that they perform in this process.

Simplification

*****To simplify the process, see if any of the activity steps are repetitive or can be eliminated. Ask the group how this step alone might improve their work processes. What would the results be?

Measurement

*****Explain that specifications are used for measurement. The input and output crossing boundaries between processes or steps within the same process are compared to a standard or average specification. Ask the group to describe how these variations from specifications might be used to better understand the process and the opportunities for improvement within the process.

*****What kinds of things might be measured in the organization's work processes? Point out that these are the factors which can be improved.

Control

*****Explain that the control step is to determine where and what controls the factors measured in each step of the process. How might these control points be found? What tools could be used to aid this task?

Improvement

Identify Opportunities

*****Note that once the process is defined and simplified, and the variable factors within it are measured and their points of control identified, the opportunities for improvement can be determined. List these opportunities for each step of the process.

Cause and Effect Planning

*****Remark that a useful tool in establishing the causes and potential solutions for problems is the cause and effect technique. The use of this tool will be discussed in more detail later. Its use results in discovering the most likely causes for problems in the process.

Action

*****Once the caus : for problems have been listed for the improvement opportunity, actions to implement a solution need to be arrived at. Ask the group to list important things to consider when proposing an action?

*****If these questions are not answered in the discussion, bring them up: How is the best of the solution alternatives selected? Who is responsible to see the action through? How should this responsibility be delegated? How might essential resources be secured? Should a deadline be set? Who can approve the action?

Cross-functional Processes 10 min

*****Note that the subject of multi-functional issues in organizations has been discussed before in this course. Now we will look specifically at the issue of multi- or cross-functional processes.

Functional interdependence

*****Ask the group to describe considerations which arise when one independent functional group within an organization depends on another in its work.

Input

*****Define input in this context as the product or information that one function requires for its work. Ask the group to discuss difficulties that functional areas sometimes have in obtaining the input they need.

Output

*****Define output as the product or information that one function issues as a result of its work. Ask the group to list some of the impacts the function can have on other functions through its delivery of this output.

Coordination

*****Comment that you think the group will agree that coordination between functions with input-output relationships is essential to the performance of the organization. Ask the group to suggest reasons why this coordination is often so difficult and in many cases does not get done.

*****If the group has not suggested this after some discussion, note that often this coordination between functions is lost because the functions are not in the same chain of command.

*****Ask the group what the result of breakdown in coordination of this type might be.

*****Ask if this means no one is responsible for seeing that the process proceeds. Note that the fact of life is that someone is always responsible.

Process Ownership 5 min

Responsibility

*****Ask the group who it is who is usually held responsible.

*****Comment that the person most knowledgable about the process, or who controls the largest portion of the process, will naturally be the person to make responsible for the process. This person is called the process "owner." (If discussion develops that someone in a higher supervisory role is responsible, just note that carried to the extreme the organization chief is ultimately responsible for all the processes, but that responsibility is delegated to the person who actually does the work as being most knowledgable.)

Authority

*****Note that the owner will often not have authority over some of the other functional areas which work on the process. Ask the group to discuss problems this presents.

Pride

*****Ask the group how "pride of ownership" can contribute to owners efforts to see that the processes for which they are responsible run smoothly, and are improved.

Process Extension 10 min

Downstream

*****Downstream extension is pushing the process description to include steps further toward the end user or conclusion of the process. Ask the group to suggest why this might increase understanding of the process. How would this assist in determining the impacts of steps taken earlier in the process?

Upstream

*****Define upstream extension as pushing the process definition to include steps further toward the conception and development of the needs which require the process. Ask the group to suggest why this might offer potential for improvements in organizational performance.

*****Note that often the greatest improvements for the least cost can be made at early stages in the process. Relatively few resources have been committed and small improvements will be multiplied many times over when carried through the whole process. Ask the group who it is who makes the decisions regarding conception and development of needs at these early stages in the process. Ask the group how these decision makers might make better decisions in the long run.

Difficulties

*****Ask the group if it seems futile to extend the process upstream to consider these critical developmental decisions, when often these decisions are out of control of the process owner.

*****Note that often it is difficult because no one really knows how these decisions are made, and it takes a lot of digging to find out. Ask the group if this digging would be worthwhile. Why or why not?

Session 10 Process Flow Exercise

Objectives: To allow the group to identify a process in a multi-functional environment. The process interfaces will be determined, along with the input and output passed between these functions.

Lesson Plan: Introduction 3 min

*****Review that last hour we looked at the process perspective, how to view work activities as they fit into the bigger picture of processes.

*****This hour we will take a familiar example from everyday experience and see how to detail the process.

*****Review the lesson objectives above.

Process Excercise

Introduction 2 min

*****Announce that the process to be considered is getting your body out of bed in the morning and getting it to work. Elaborate that this is a typical day, there is work to be done, no sneaking off to the golf course or the tennis courts, it's out of bed and to work.

Process Flow Diagraming 15 min

*****Have the group list the steps in getting to work. Write them down with plenty of room to fit steps suggested later in between earlier ones. Take your time. Get all the details. Show some enthusiasm as needed to get the group rolling.

Cross-functional aspects

Function Identification 6 min

*****Ask the group to identify functional areas within this process. Note that even though for the most part all operations are performed by yourself, consider yourself to be performing different functions as makes sense.

*****Have the group describe the interfaces between these functional areas. What is the input-output passing from one to another?

Input Identification 6 min

*****Ask the group to consider the process they have identified and note where input is needed from outside the process. What is this input and who provides it?

Output Identification 6 min

*****Have the group consider the process they have identified and note where output is issued out of the process. What is this output? Who is it provided to? How does it impact the process?

Ownership 2 min

*****Ask who is the owner of this process? What does this mean?

Extension 10 min

*****Ask the group to extend the process even further up and downstream, if possible. Ask what decisions, factors, or occurances impact the process from the lead or upstream end.

*****Ask the group to describe the effect on overall performance that a small change made at the upstream end could produce.

Session 11 Process Flow-charting

Objectives: To provide further experience in describing the underlying processes comprising the workplace.

Materials: Standard job descriptions or occupational instructions for a programmer, a design engineer, and an construction inspector at your base.

Lesson Plan: Introduction 5 min

*****Tell the group that this hour they will have an opportunity to apply the process identification tools we have learned to situations they are familiar with, but are a bit more realistic for a work situation.

*****Review the lesson objectives above.

*****Assign and distribute the three job descriptions as cases, one to each person, so there are an equivalent number of people for each case. Explain they should read the case and pay attention to the processes they can identify. They will have a chance to discuss the details shortly. Tell them they have five minutes to acquaint themselves with their cases.

Read Cases 5 min

Panel Discussion 36 min

*****Have a team of members who all read the same case assemble at the front of the room. Inform them that this is a panel discussion type forum. They are to respond to the questions given. Interaction and alternate opinions by other panel members are encouraged. Ask for a volunteer from the panel to volunteer to summarize the case. Move through the questions as the panel is ready, or as time requires. Each panel has twelve minutes. Suggested times for each question are given. When one team is done, repeat the panel procedure with each of the other teams.

Summarize the case. 2 min

Describe the processes evident in the case. List the steps which comprise these processes.

3 min

Which separate functional units are interfaced with in each process?

2 min

Who is the process owner? Over which steps in the process does the owner have personal authority?

2 min

What are elements of input and output evident in these processes?

3 min

Conclusion 4 min

*****Ask and discuss:

How can defining the process in work situations assist in managing and improving the organization's performance?

*****Tell the group that the rest of the afternoon we will look at the definition of performance and how to measure various aspects of performance.

Session 12 Definition of Performance & Customer Satisfaction

Objectives: List and define the seven components of performance. Discuss which are most appropriate for the Engineering Branch.

Understand the important role of customer or user satisfaction in improving performance. Identify who customers are of the Engineering Branch.

Reference: Planning and Measurement in Your Organization of the Future, by D. Scott Sink and Thomas C. Tuttle, 1989, pp171-186.

Lesson Plan: Introduction 5 min

*****Review the lesson objectives above.

*****List and briefly define the seven components of performance. Tell the group these are the components of performance we will be discussing.

Effectiveness - How well you get the job done
Efficiency - How well you utilize your resources
Productivity - The ratio of output to input
Quality - The degree to which your processes are accomplished well
Innovation - Your creative improvement ideas
Quality of Work Life - The attractiveness of the workplace
Budgetability - How well you meet your resource constraints

Performance Component Definition

*****For each component, give the operational definition.

*****Ask the group for applications within their organization. When several have been suggested, ask the group if they agree that each is a correct application of the component. Why or why not?

*****Ask in what ways the group feels that component is important in defining their performance.

*****Have the group members refer to the performance component diagram at the end of the lesson as needed with each component to assure an understanding of the meanings.

Performance Components

Effectiveness <u>4 min</u>

Operational Definition -

*****The ratio of actual output to expected output. This is an output side component.

Possible applications -

How important is this as a component of performance?

Efficiency <u>4 min</u>

Operational Definition -

*****The ratio of expected input to actual input. This is an input side component.

Possible applications -

How important is this as a component of performance?

Productivity <u>4 min</u>

Operational Definition -

*****The ratio of output to input in the same units.

Possible applications -

How important is this as a component of performance?

Quality <u>4 min</u>

Operational Definition -

*****The degree to which each step of the process, and the process as a whole, operates correctly.

Possible applications -

How important is this as a component of performance?

Innovation <u>4 min</u>

Operational Definition -

*****An index of the creative process of changing to respond to new pressures, opportunities, and threats.

Possible applications -

How important is this as a component of performance?

Quality of Work Life <u>4 min</u>

Operational Definition -

*****The reaction of the organization's personnel to the work environment, including factors such as pay, leadership, autonomy, involvement, and relationships.

Possible applications -

How important is this as a component of performance?

Budgetability <u>4 min</u>

Operational Definition -

*****The relationship of budgets and goals with actual costs and accomplishments. This component is comparable to profitability in a private organization.

Possible applications -

How important is this as a component of performance?

*****Note that there is a diagram at the end of the lesson showing the process model and its relation to these seven performance components. Have the students flip to the diagram and ask if there are any questions.

<u>Component Importance</u> <u>2 min</u>

*****Ask:

Effectiveness and quality have been suggested as the two components most critical to the performance of a civil engineering organization. The other components depend on these two. Do you agree? Why might you think this to be the case?

<u>Customer Satisfaction</u>

*****Note that several of the above components of performance are concerned with the user's attitude toward the organization's output. To borrow a term from the commercial world, customer satisfaction is an important perspective for any organization.

Importance of Customers 5 min

*****Ask:

Why is customer satisfaction important to the Engineering Branch?

*****Why should you care what they think?

*****If you have designed a good air conditioning system or parking lot, what concern should you have with the user's satisfaction?

Identification of Customers 10 min

*****Ask:

Who are customers of the Engineering Branch?

*****Elaborate that we are not interested just in other organizations C.E. builds and maintains facilities for. Who are the organizations that use the products the Engineering Branch produces?

*****If base contracting and contractors themselves have not been mentioned after some discussion, ask: Can you consider contracting a customer? Can you consider the contractors who bid and build your projects as customers?

*****Ask:

How does the Engineering Branch serve each of these customers? How can they be better served?

PERFORMANCE COMPONENT DIAGRAM

```
           ---------------Budgetability------------
           |                                       |
           |-------Productivity--------            |
           |                          |            |
           |                          |            |
           |                          |            |
           |                          |            |
           |          Innovation      |            |
           |              |           |            |
USER ---- INPUT -- TRANSFORMATION -- OUTPUT ---   USER
NEED            |         |           |        SATISFACTION
                |         |           |
                |     Quality of      |
                |      Work Life      |
                |                     |
           Efficiency          Effectiveness

|______________________Quality_____________________________|
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Note: The definitions and diagram for the performance components presented in this lesson are based on those proposed by D. Scott Sink and Thomas C. Tuttle in their book Planning and Measurement in Your Organization of the Future, Norcross, Georgia: Industrial Engineering and Management Press, 1989.

Session 13 Application of Performance Components

Objectives: Apply the components of performance to the Engineering Branch environment. Suggest elements of performance which could be targeted for evaluation and improvement under a performance management framework.

Lesson Plan: Introduction 5 min

*****Recap the performance components from last lesson. Remind the group that customer satisfaction is an important perspective for engineers.

*****Review the lesson objectives above.

Paired application analysis 25 min

*****Divide the group into pairs, making a team of three if there is an odd number. Remind the group that in last hour's discussion potential applications for each of the components of performance were briefly discussed. Now your task will be to consider just one of these in more detail. Assign the components to teams, one per team, in the following order: effectiveness, quality, efficiency, productivity, budgetability, innovation, and quality of work life. Tell them their assignment is in their handbook. They have 25 minutes. Then each pair will present their conclusions to the group.

Critically analyze one of the components of performance in its application in your organization.

What is a reasonable operational definition of this aspect of performance? How can it be measured or evaluated in your organization?

Suggest how this would allow managers to track performance and determine where improvement is possible. How would the improvement be recognized and reported?

Presentations 20 min

*****Have each pair present their conclusions, 3 - 5 minutes per pair.

Session 14 Implementation Details

Objectives: Outline the steps involved in a top-down implementation of a Performance Management Framework.

Illustrate the technique of using a pilot project to initiate the program.

Describe the importance of the facilitator to the operation of the team function.

Lesson Plan: Introduction 3 min

*****Review the objectives.

*****Announce that now that we have spent the last two days discussing the tools and outlook needed to use the Performance Management Framework, it is time to pull these ideas together and see how they are used to improve the work in an organization.

Paired individual analysis 25 min

*****Divide the group into teams of two. Assign one of the five main topics to each group. Have them consider the individual issues under each topic, and prepare to brief the class according to the following instruction. Tell them they have 20 - 25 minutes to prepare their presentations, and then each team will have 3 - 5 minutes to present. If there are insufficient teams to cover all five topics, combine first Management direction with Management support, second Team process definition with Team improvement efforts.

Describe how the following need to be addressed within the context of the Performance Management Framework in order to promote successful improvement efforts.

Management direction

Strategic planning

Identification of principal processes comprising work

Selection of process as pilot project for first improvement effort

Selection of process for next team improvement effort

Management support

Assignment of members to the team

Training decisions

Selection of a facilitator to assist team

Team process definition

Steps

Input and output

Ownership

Interfaces

Team improvement efforts

Identify problems

Propose solutions

Recommend actions

Who responsible

Schedule and milestones

How to measure for success

Management implementation

Screen implementation actions

Support implementation actions selected

Reward efforts

<u>Presentations</u> <u>20 min</u>

*****Have teams take turns presenting their conclusions, allowing 3 - 5 minutes per team.

<u>Conclusion</u> <u>2 min</u>

*****Inform the group that they should now have a complete picture of how to go about conducting the Performance Management Framework in an organization. Announce that for the rest of the morning they will have a chance to go through these steps in an exercise environment.

Session 15 Implementation Exercise

Objectives: Provide a situation in which members can experience implementation of the Performance Management Framework.

Discuss the lessons learned and how they might be applied to the program implementation in the Engineering Branch Environment.

Materials: Several dozen 8-1/2 x 11 sheets card stock or other heavy construction paper (buff color is fine), masking tape, unsharpened pencils, typing paper, scissors, 12 inch scales, drafting triangles.

Lesson Plan: Introduction 5 min

*****Tell the group that the rest of the morning will be a workshop exercise to practice the principles of the Performance Management Framework. They will have a chance to look at a situation from both a management and worker perspective.

Exercise

Situation 30 min

*****Read the following description of the situation.

You are an engineering branch comprised of three sections, programming, design, and construction management. Due to the limited scope of this exercise, construction management will actually do the construction called for in the exercise. Your task is to program, design and build the items identified.

Part of this task requires costing of labor and materials to be used. Costs are:

Line Item	Cost
Whole sheets of construction paper	$10 / sheet
Unsharpened pencils	$ 5 / each
Tape	$ 1 / inch
Labor by builder	$ 2 / minute

Note that sheets of paper are charged as whole sheets, even if only a portion is used. The left over cannot be used on another project. Tape cannot be used in shorter than one inch pieces. Pencils cannot be broken.

*****Divide the group into teams of 3 - 6 people. Within each team, 1 or 2 people will become programmers, 1 or 2 will be designers, and 1 or 2 will be construction management. Each set will perform the same exercise below. Inform all members that one project is design complete and has been on the shelf, but just got funded. Give a copy of this to all the construction management people. One project is programmed, awaiting design. Give a copy of this to the designers. There is a pile of projects waiting to be programmed. Give a copy of these to the programmers.

*****Give a copy of the following written instructions to the programmers, designers, and construction managers. Only give the appropriate instructions to each member. For instance, the designers would get the designer instructions but not the programmer or construction manager instructions.

*****Ask for questions. Tell them to begin.

*****As programming submits cost estimates for approval, compare to the following list. If the cost is equal to or less than the list, simply reply "approved." If it exceeds the list, simply reply "too much, disapproved." Do not tell them how close they came in either case.

Item	Ceiling Cost
Block	$ 44
Pyramid	55
Container	85
Airplane	30
Birdhouse	75
Box	90
Buggy	60

*****At the 5 minute mark, go to the programmers and say, "I have a change in the container, it needs to have 2 compartments with 15 square inches in each, and still have 4 compartments with 4 square inches in each." Do not tell the programmer, but this will raise the ceiling cost above to $ 105.

*****At the 10 minute mark, go the the designer, ask how the box is coming. If they have not seen it yet, complain that you needed it yesterday for the Wing Commander. Remind the designer that it is high priority, and why is he/she working on anything else. Also tell the designer that you have a change in the pyramid. You need a square hole just big enough for a pencil to fit through half way up in the center of 2 opposite sides. This may require reprogramming.

*****At the 15 minute mark, go to the programmer and say there is a change on the birdhouse. It now needs a weathervane on top, mounted on a pencil. Ask for a new cost including this change. If under $ 85, approve.

*****At the 20 minute mark, go to design and ask about the box again. Remind of its importance. Go to the programmer and say that the airplane just got hot and is now high priority. Expedite.

*****At 25 minutes, go to design and say that the airplane needs to be able to carry three 2 inch square pieces of paper, otherwise the same requirements as before.

Instructions for Programmers

You have been given a stack of user requests. Your job is to determine a cost estimate for the project, line by line and total, per the unit costs provided in your handbook. You must then get this cost approved by the class leader, who will compare the cost to the limits of available funding.

Then pass the sheet describing the user request, along with this cost estimate, which becomes the programmed amount, to design. If you are two people working together as programmers, work together on one project at a time.

From time to time, design may come to you asking for a change in programmed amount. You may do this by submitting a new cost estimate to the class leader for approval.

Instructions for design

You are to prepare written instructions with sketches and drawings as needed to describe to construction how to make the item. Prepare a detailed cost estimate corresponding to your design. Deep within the cost set by programming +/- 10%. If this is not possible, go to programming and ask for a change in programmed amount. You do not have to follow their line items, just compare to the total.

Pass the design instructions, sketches, drawings on to construction, but not the users list of requirements. Give construction a lump sum cost estimate. Construction will quit work when they reach this cost.

From time to time construction may come to you needing a change order. You must provide direction as needed and approve the extra cost or savings for the change, based on the change in materials and labor. The construction management persons time continues to run during this time, and must be included in the total cost. There is also a $1 charge for each change to cover administrative overhead. The resulting total cost must still be within the programmed amount tolerance as above.

Try to keep construction busy all the time, but recognize that once they have started a project, they cannot stop until it is done or cancelled due to no funds to continue. This is your call. You may cancel a project if you see no feasible way to continue. But then it can not be restarted.

Instructions for construction management

Use the materials to construct the items according to the design provided. Keep track of your time and materials on each project. Quit work when you reach this cost. If this happens, or if the design is too vague, or contradicts itself, or does not work, go back to design for a clarification change order. Your time continues to run against the project during this time. Assist design in understanding the problem even suggesting a solution if it is apparent.

Once you have started a project, you may not quit until it is finished or design informs you that the project is cancelled.

This project is design complete. Give to construction.

Item: Block

Lump Sum Cost: 37

Design

```
 -----------------------------------------------
 :                                             :
 :                                             :
 :                    :---------:       2"     :
 :      --------------:  - _2_ -:----          :
 :     :                              :        :
 :     :    3     :  2 :    1    : 2  :   3"   :
 :     :--------------  - _-_ -  ----:         :
 :                    :    2    :              :
 :                    :_________:       2"     :
 :          4"     2"      4"       2"         :
 :                                             :
 -----------------------------------------------
```

Cut the shape shown out of an 8-1/2 x 11 sheet of construction paper. Fold on the four dotted lines between the rectangle marked 1 and the rectangles marked 2. Make 90 degree folds so that the four rectangles marked 2 come up to be the sides of a box while the rectangle marked 1 rests on the table. Now tape the corner joints together where the rectangles marked 2 now touch each other. Use 2" pieces of tape positioned to completely seal the joint. Now fold on the dotted line between the one rectangle marked 2 and the rectangle marked 3. Make a 90 degree fold so that the rectangle marked 3 becomes the top of the box. Completely seal the three joints created between the rectangle marked 3 and the other rectangles marked 2 with tape. For this purpose, two pieces of tape will be 4" in length and 1 piece will be 3" in length. Position the tape so the entire joint is sealed.

This is the cost estimate for the block, which is design complete. Give this to design. Construction has the design.

Paper	1 sheet @ 10 =	$ 10
Tape	21 inch @ 1 =	21
Labor	3 minutes @ 2 =	6
Total		$ 37

This is the user request and programmer's cost estimate for the block.

Item: Block

Need: A block of six sides, two of which have at least 6 square inches, two have 8 square inches or more, and two have at least 12 square inches. All seams are to be completely sealed.

Priority: moderate

Programmer's Estimate:

Paper	1 sheet @ 10 =	$ 10
Tape	18 inch @ 1 =	18
Labor	3 minutes @ 2 =	6
Programmed Amount		$ 36

This is the user request and programmer's estimate for the pyramid, which is programmed awaiting design. Give this to design.

Item: Pyramid

Need: A pyramid with a square base of 64 square inches and 4 triangular sides sloping in toward a point. The point shall be at least 5 inch tall. A single pencil is to project through the point vertically, with one end resting on the base of the pyramid. The joints do not need to be completely sealed.

Priority: High

Programmer's Cost estimate:

Paper	2 sheets @ 10 =	$ 20
Tape	12 inches @ 1 =	12
Pencil	1 each @ 5 =	5
Labor	5 minutes @ 2 =	10

Programmed Amount $ 47

Item: Container

Need: One tray with 5 compartments, open on top but with compartments otherwise completely separated, with the joints sealed, from the others. One compartment shall have a minimum of a 15 square inch bottom. The other four compartments shall have a minimum of a 2 square inch bottom. Each compartment's sides will be as tall as the longest side dimension of that compartment. The outer sides of the tray will be no shorter than the tallest sides to any one compartment.

Priority: Moderate

Item: Airplane

Need: A paper airplane which will fly at least ten feet when thrown. It must be able to carry cargo of three 2" x 1" squares of paper. These pieces of cargo must fit entirely within a cargo area in the airplane so that they are completely out of view, without touching each other. When the plane impacts after its flight, the cargo must not be ejected or exposed to view. They may not be taped in directly.

Priority: Low

Item: Birdhouse

Need: A birdhouse with four vertical sides, each seven inches high, minimum. A sloped roof and a floor, minimum 16 square inches, are required. Each side will have a hole big enough for a bird the size of your thumb to go in and out. Just under the hole will be a perch extending at least two inches out from the side.

Priority: High

Item: Box

Need: A box with a lid. When the lid is in place, the box must contain 250 cubic inches. The lid of the box is to have handles to lift it off. The handles are to be pencils. The pencils are to stick out at each of the four corners of the lid at least 1" at each corner. Joints do not need to be completely sealed.

Priority: High

Item: Buggy

Need: An enclosed cabin with 60 cubic inches space. A two inch square door in each side with a one inch square window elsewhere on each of the two sides. Four wheels, mounted on two axles, supporting the cabin to a height at least two inches off the ground. Axles must not penetrate the cabin.

Priority: Low

Management Initiation — 15 min

*****Stop the situation exercise. Settle the group down all together again. Tell them they are now a management team. They want to use this Performance Management Framework. Tell them they have 15 minutes as a group to accomplish the steps needed for management to initiate the framework. They need to select who will be on the team (hypothetically, in actuality they will all participate on the team.). They need to choose a process for the team to work on. They need to select a facilitator for the team. They need to decide what training is needed: who, what, when, where and how. Ask for questions and get them started.

Break — 10 min

*****Stop the group for a break.

Team Time 1 — 25 min

*****Inform the group that they are now the team selected by management to study the process selected in the last meeting. They have received the training decided upon. Ask who was selected to be the facilitator. Tell the group that the facilitator will now lead a team meeting through defining the process, extending it, determining its owner, listing input and output, and to begin identifying problems at each stage of the process. Use brainstorming techniques. Tell them they have 25 minutes, and to structure their time to be getting to problem listing by then. Invite the facilitator to come to the front and lead the meeting. Ask for any questions and let them start.

Team Time 2 — 25 min

*****Stop the previous meeting. Determine their progress. Tell them to pick up the pace or slow down for more detail, depending if they are behind or ahead of starting to list problems. Ask the facilitator to pick a new facilitator. Tell them they again have 25 minutes, and should finish the problem listing and continue into solution generation. Invite the new facilitator to come to the front and lead the meeting. Ask for any questions and let them start.

Break — 10 min

*****Interrupt and give them a 10 minute break.

Team Time 3 25 min

*****Have the facilitator pick a new facilitator. Tell them this is the last 25 minute team time. They need to finish proposing solutions and make specific action recommendations. Who would be responsible? How would the effect be measured to see if improvement resulted? Invite the new facilitator to the front of the room. Ask for any questions and let them begin.

Management Implementation 10 min

*****Tell the group they have now gone through the steps needed in their organizational setting to arrive at actions to improve problems in their work processes. Tell them they are now management again. You have the actions recommended. You can only pick two because of funding constraints. Choose them. Decide how to reward the team for their efforts.

Debrief 15 min

*****Lead the group through a discussion of the following questions.

What was the hardest part of the Performance Management Framework exercise? Why?

What was the easiest part? Why?

What surprised you the most in working through the Performance Management Framework?

Where do you see the greatest hindrance in doing this in your actual work? How can this hindrance by overcome?

What advantages and benefits do you think can be achieved by using the Performance Management Framework in your organization?

Session 16 Measurement Exercise

Objectives: Understand the importance of measurement in evaluating and improving performance.

List reasons for measuring.

Define what to measure as the products which pass between steps in the process, from internal suppliers to internal customers.

Examine a method for analyzing variance between these steps.

Lesson Plan: Introduction 3 min

*****Review the objectives.

*****Note that the topic of measurement is not given much emphasis in the engineering community because it is so difficult to measure what is done. We will look at some tools to make this job easier.

Measurement

Importance 3 min

Why is measurement important in evaluating and improving performance in your organization?

*****Note that experts on measurement systems claim that you cannot manage what you do not measure. Why might this be true?

Reasons for 4 min

What uses can you see for measurement of your performance? How can it help managers understand, control and improve the work of the organization?

*****Ask the questions above. Get several peoples ideas.

Variance 2 min

What is variance? What is the relationship of variance and measurement?

*****Define variance as the difference to a standard or average for some factor of a process. Ask the second question above.

External 3 min

What are some measures of end product variance that might be used in the Engineering Branch?

*****Note that the most common kind of measurement or check against specification is the end product inspection, when the item is ready for the user. Ask what are some measures of this type for the engineering branch.

Internal 5 min

Where is variance located within the work process?

*****Remark that a less obvious measurement point is within the process, between steps for example. These are at the internal provider - supplier interfaces. Ask the above question. Follow with the following questions.

How might variances at earlier steps in the process affect variances at later steps in the same process?

How can measuring and controlling variance at early steps in a complex process help control the end result?

How effective might improvement efforts be at this early point in the process?

*****Prod the group to think further by asking if it is worth the energy to measure within the process, or is end result measurement the only worthwhile method. Why?

Variance Matrix 30 min

*****Ask each person to take a few minutes to read over the following description of the Variance Matrix.

The variance matrix analysis is a tool that helps identify the key variances which affect variance in subsequent steps in the same process. The steps in a variance matrix analysis are:

Step 1: Begin with the list of steps which make up the work process being evaluated. This includes every action needed to transform the inputs to outputs.

Step 2: Group sets of individual steps together into clusters. Each cluster should accomplish an identifiable change in the product in its transformation from input to output. This simplifies the analysis by concentrating a fewer number of main steps.

Step 3: Identify all possible sources of variance in each step. These are the causes of the work not conforming to the standard or norm set for it.

Step 4: List variances in order of how they might occur in the process, matching each to the corresponding major step in the process.

Step 5: Identify upstream variances that impact or interfere with the control of downstream variances. A variance matrix is used for this purpose. Check each variance against all downstream variances listed beneath it. If a variance impedes control of a downstream variance, a mark is made.

Step 6: Locate key variances, those which impede control over several downstream variances. The degree of impact the variance has directly on cost and quality is also considered.

Step 7: Establish the factors which are important in controlling these key variances.

*****Note that there are likely to be questions about what was just read, but to hold them because now we will work through an example that should clear a lot up. Questions will be answered after that.

Example analysis using the variance matrix.

The process is the operation of a machine which assembles ham and cheese sandwiches.

*****This simple process is making ham sandwiches. Steps 1 and 2 in the Variance Matrix analysis are illustrated below. The detailed steps in the process are listed on the right, and are grouped into major steps as shown on the left.

Clustered Major Steps	Actual Steps
Prepare Bread	Replenish bread and mustard Fill machines Sort bread onto assembly tray
Add ham	Get container of ham Slice ham Position ham on bread

Add cheese	Get container of cheese Slice cheese Position cheese on ham
Insert lettuce	Cut lettuce Remove lumpy lettuce Position Lettuce on cheese
Finish sandwich	Obtain bread for top Position bread on lettuce Cut sandwich
Package sandwich	Insert sandwich in machine Insert cardboard slip Prepare labels

*****Steps 3 and 4 in the Variance Matrix analysis are illustrated below. Individual variances were determined and then listed, clustered with the major step they correspond to, which are listed across the top. Refer, for example, to the major step "insert lettuce". The variances 14 and 15 can be seen listed under this step. Similarly, the variances for each step are listed beginning under the appropriate step, and in order of potential occurrence.

The Variance Matrix

```
Prepare   Add  Add       Insert    Finish    Package
Bread     Ham  Cheese    Lettuce   Sandwich  Sandwich
        :      :         :         :         :
1 Bread soggy
x2 Edges curled
xx3 Bread crooked
   4 Bottleneck
          5 Ham too warm
           6 Slices too thick
            7 Ham shredded
             8 Ham spoiled
 x            9 Ham crooked
               10 Cheese Moldy
                11 Cheese unwrapped
               x 12 Slices stuck together
 x                13 Cheese crooked
                         14 Lettuce lumpy
                          15 Lettuce wet
                                   16 Run out of top slices
                                    17 Slices wrong size
            x    x       x           18 Top not level
xx              x x      x           x19 Cut quality
                x        xx         x x      20 Package qual
xx         x  x x x      x          xxx      x21 Too big
x          x  x x x      xx         xxx      xx22 Not sealed
                                                23 Bad label

X  X      X  X XX        X                     X  Key Var.
```

*****Steps 5 and 6 in the Variance Matrix analysis are also illustrated above. For each variance, beginning with number 1, the list below that variance was scanned for any variances which might be affected by the preceding variance. Such relationships were marked with an "x". For example, note that variance 15 was determined to possibly affect variances 20 and 22, while variance 16 had no effect on subsequent variances. The key variances were then selected, and noted with a "X" at the bottom row. These were selected because of their multiplied effect on other variances or because on their own they were important enough to be called a key variance.

*****Step 7, not illustrated above, would then be to determine factors which control the behavior of the key variances.

*****Ask for any questions.

*****Note that this information would then be used to help determine which opportunities in the process are most suited to improvement efforts.

Session 17 Cause and Effect of Measurement

Objectives: Understand the importance of measurement, and the components of an effective measurement system.

Reference: The cause and effect technique is adapted from DOD 5000.51-G, Total Quality Management, A Guide for Implementation, dated 15 Feb 89.

Lesson Plan: Introduction 3 min

*****Read session objectives above.

*****Explain that the cause and effect technique is a valuable tool not only for measurement, but to take apart any situation and analyze the components and relationships, to understand them better.

Cause and Effect Technique 17 min

*****Ask the group to take a few minutes to read over the following description.

```
          Major Cause              Major Cause
     ---------->|                     |<----------
        Minor   |                     |  Minor
       Causes   |                     |  Causes
     ---------->|                     |<-----------
                |                     |
     ---------------------------------------> Result
            |                     |
 ---------->|                     |<------------
  Minor     |                     |   Minor
 Causes     |                     |   Causes
 ---------->|                     |<------------
            |                     |
     Major Cause           Major Cause
```

What: Represents the relationship between an effect (problem or result) and its potential causes.

Why: The diagram is drawn to sort and relate the interactions among the factors affecting the result.

How: 1. Name the problem

2. Decide the major categories of causes. major causes may include: data and information systems, dollars, environment, hardware and equipment, materials, measurements, methods, people, and training.

   *****Note that the four most common major causes used are machines, methods, people issues, and materials. These four, in many situations, provide the guidance and structure needed to determine the causes.

3. Brainstorm for more detailed causes.

4. Eliminate causes that do not apply.

5. Discuss the remaining causes and decide which are most important.

6. Work on most important causes.

7. Eliminate or control causes.

*****Note that each branch can have as many levels of sub-branches as desired. For instance, for the effect of being late to work, a factor on the machine major cause branch might be the alarm clock did not sound. A further sub-branch might be that the power went off. A further sub-branch might be that the power bill had not been paid.

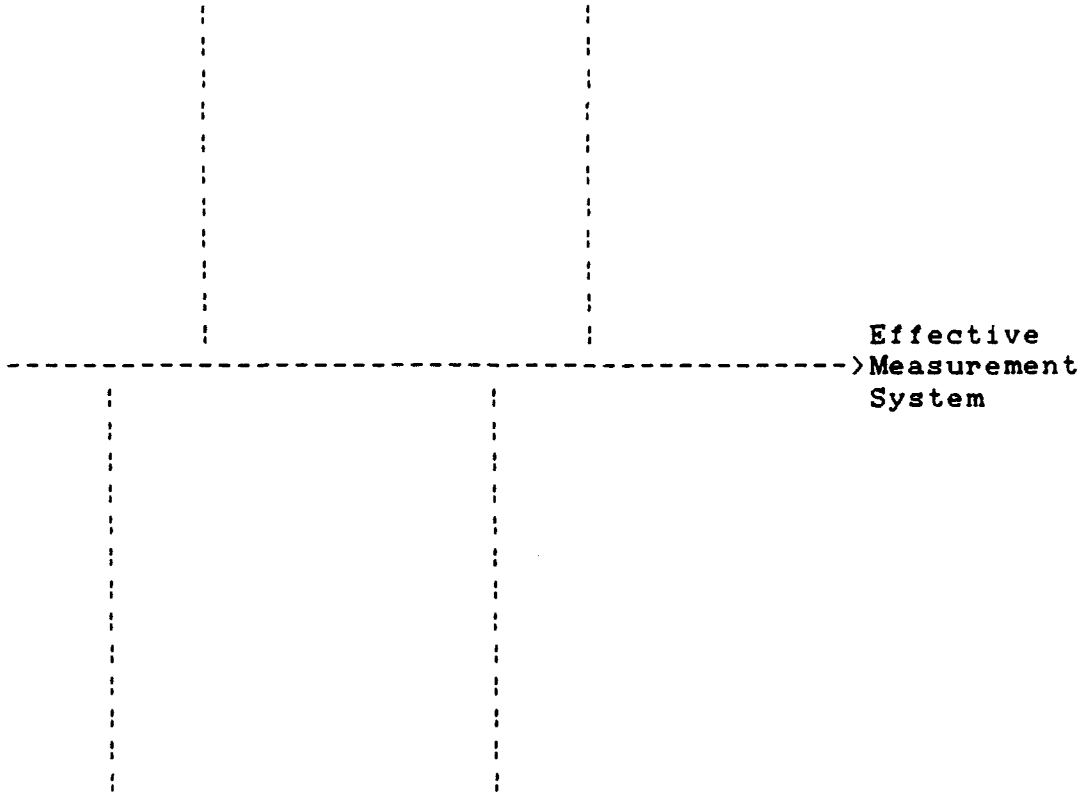
*****Ask for questions. Refer questions to the group to see if someone else present can answer them. If there are no questions, challenge the group by asking them how they would start such an exercise. What kind of effect might they choose to look for causes of?

Cause and Effect of Measurement 30 min

Cause and Effect Analysis for an Effective Measurement System

*****Note that this analysis will be a variation on the customary cause and effect technique. Usually the effect examined is a problem the organization is trying to improve by discovering the causes. Here we will assign the effect to be a desirable outcome.

*****Ask for a volunteer to come and record the causes brainstormed by the group on a pad or overhead. Tell the group to come up with major causes and factors related to these causes for the given effect. What is needed for an organization to have an effective measurement system. Ask for any questions. Have them begin.



*****If the group seems stuck, prompt specific causes such as "what factors do we need in our people, what must be true of our people to have an effective measurement system." Use similar questions for other major causes, or questions to prompt sub-branching from causes they have already listed, to flesh out the causes.

Session 18 Objectives Matrix

Objectives: Demonstrate a technique to summarize non-related measures into a composite score.

Describe the distinction between product, process and surrogate measures, and the advantages of each.

Introduction 7 min

*****Review the objectives listed above.

*****Ask - How many of you have ever bought or sold a used car? What factors do you look at to determine a fair price?

*****After some factors have been listed, ask - Which factors are the most important?

*****Tell them what they have done in these cases is aggregate different factors into one index - price. You had to decide which factors were most important and what they were worth. This same method can be used to evaluate the work you do in your organization through a tool called an objectives matrix. Before we look at how to use the objectives matrix, we will look at some of the different types of measures that are useful in evaluating performance and aggregating into an objectives matrix.

Types of Measures 8 min

*****Read through the following definitions. Then read the example that follows the definitions.

Product Measures - Actual attributes of item ready for user

Process Measures - How product was attained

Surrogate Measures - Reflect actual attributes

*****Relate this example. Suppose the factor we want to measure is completeness of a design submittal from an A-E. What you would like to measure is the number of mistakes and the number of missing elements in the design and specifications. This would be a product measure. However, to measure this is virtually impossible. The number of mistakes often cannot be determined until the project gets into construction and some contractor is actually trying to build what is called for. Some other measure is needed.

*****Continue. Another possibility is to measure the time spent checking the drawings for errors and omissions. This is a process measure. It does not measure the completeness of the design itself, but the effort the organization uses to complete the design. The thought is that the more time spent checking the drawings, the more errors will be caught. Clearly, the time spent checking drawings is easier to measure than the actual number of errors and omissions. But as a process measure, it is not as trustworthy as the product measure.

*****Continue. Another alternative is to have the chief of design check the submittal and count the comments he or she comes up with. This is a surrogate measure. The idea is that the chief will spot some percentage of the actual errors and omissions, which will give an estimate of how complete the design actually is. This measure is much easier to achieve than the product measure. However, the surrogate measure is not as trustworthy as the product measure, because not all the errors are caught, just the ones the chief sees.

*****Ask for questions. Then proceed to the following questions.

What are the advantages and disadvantages of each?

What precautions are needed when using process and surrogate measures? How can you check their validity?

Objectives Matrix Worksheet 25 min

*****Inform the group that now we will examine the objectives matrix as a way to combine various measures into a single index of performance. Instruct the group to work through the worksheet in their handbooks. Ask them to consider the measures listed and think about what type the measures are: product, process, or surrogate. Tell them that they can work individually or in twos or threes if desired. Tell them they have 25 minutes.

Objectives Matrix Worksheet

The following steps make up the objectives matrix analysis.

1. Establish Key Performance Areas (KPAs)
2. Determine Key Performance Indicators (KPIs)
3. Generate transformation curves
4. Assign relative weights
5. Compute performance index

1. Establish KPAs

KPAs are those performance components that are considered important to the organization's success. Usually these are determined by management or reflect the policies and objectives set by management. For example, the design branch may have the following as its KPAs.

Quality of the transformation process
Efficiency of manpower use
Effectiveness in the form of timeliness
Quality perceived by the user
Quality of the drawings and specifications
Productivity

2. Determine KPIs

Next a measurable characteristic must be found for each of these KPAs. These must be accurate, quantifiable, and representative of the performance component being measured. For example, KPIs for the KPAs above might be:

Efficiency	Direct Productive Manhours/ Total Manhours
Effectiveness	$ Value Late Projects x Days Late
Quality of product	# Errors found by design chief at 100% complete
Quality to user	User Survey Response, scaled 1 - 10 Post-Design
Quality to user	User Survey Response, scaled 1 - 10 Post-Construction
Quality of process	Total # Change Orders/Total # Contracts
Productivity	$ Value Designed/Manhours Used

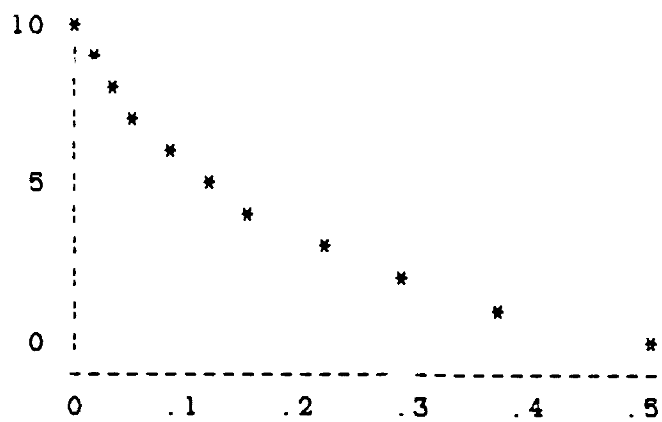
3. Generate transformation curves

This is the principal distinctive of the objectives matrix analysis. The dissimilar performance indicator measures are converted into similar ten point index scores. These scores can then be combined as a weighted average into an overall performance index. The transformation curve is created individually for each KPI by first determining the anchor values, and then filling in the intermediate values. The anchor values include the zero and ten values on the index. Additionally, the value for three or five is fixed to further anchor the index. For example, the KPI for quality of process, the ratio of change orders, would be anchored as follows.

Index Value	Value of KPI measure
Zero	.5 (If change orders total half of the project cost, award no points)
Five	.12 (Anchor the midpoint at the historical mean of 12%)
Ten	0.0 (The best possible is no change orders, award full points)

Then fill in the rest of the scale. This can be done in any combination of linear or curved relationships as seems appropriate for the measure. Graph the relationship if desired to make the function more understandable.

Quality of Process



Index	KPI
10	0.0
9	.02
8	.04
7	.065
6	.09
5	.12
4	.16
3	.21
2	.28
1	.37
0	.5

Now, fill in the values for the rest of the KPI transformation curves. Anchor values have been provided. Graph the values if desired. Use any curved or linear relationships desired to fill in the values.

Index	Effic.	Effect.	Quality to user	Quality product	Prod.
10	>.75	0	10	0	2
9					
8					
7					
6					
5	.4	3200	5	5	1
4					
3					
2					
1					
0	0	>100000	0	10	<.5

4. Assign weights

The next step is to weight each of the KPIs so they can be combined into a weighted average. The sum of the weights must be one. Give more weight to the KPIs which are believed to be most important, and which are believed to be most valid. For instance, in the list above, the value of change orders is an important measure of how accurate the design is. It is also a highly valid measure because the cost of change orders can be accurately determined. This KPI should be weighted more heavily. On the other hand, the post-design user survey is not as important. The users often cannot judge accurately the quality of the design; they do not have the expertise. This KPI should not be weighted as heavily. You be the judge on the others. Fill in the weights below.

KPI	Weight
Total $ Change Orders/Total $ Contracts	-----
Direct Productive Manhours/ Total Manhours	-----
$ Value Late Projects x Days Late	-----
User Survey Response, scaled 1 - 10 Post-Design	-----
User Survey Response, scaled 1 - 10 Post-Construction	-----
# Errors found by design chief at 100% complete	-----
$ Value Designed/Manhours Used	-----
Sum	1.00

5. Compute Performance Index

Finally, the performance index can be calculated. This is done be measuring the performance for each KPI. The measure is converted into an integer score between zero and ten using the transformation curve. These scores are then averaged into the performance index using the weights. This procedure is made easy using a table, below.

KPA	Proc	Effic	Effec	Prodt	User1	User2	Prody	Score
Raw Value	.17	___	___	___	___	___	___	
Transformation Curves	0	>.75	0	10	10	0	2	10
	.02							9
	.04							8
	.065							7
	.09							6
	.12	.4	3200	5	5	5	1	5
	.16							4
	.21							3
	.28							2
	.37							1
	.5	0	>100000	0	0	10	<.5	0
Score	4	___	____	___	___	___	___	
Weight	___	___	____	___	___	___	___	
Weighted Score	___	___	____	___	___	___	___	
Performance Index								-----

Compute the performance index for the following measured KPIs.

quality of PROCess	.17
EFFICiency	.66
EFFECtiveness	5000
quality to USER1 post-design	6
quality to USER2 post-construction	3
quality of PRODucT	8
PRODuctivitY	1.25

Fill in your transformation curve values from earlier in the worksheet. Use the same values for USER1 and USER2. Fill in your weights for the KPIs in the appropriate place in the table. Enter each raw value on the appropriate line near the top of the table. Find the value on your transformation curve which most closely matches that value. Record this value on the line given. Multiply each score by its weight to obtain the weighted score. Sum these weighted scores and record the result at the bottom of the table as your performance index. This number should be between zero and ten. The closer to ten, the better overall performance for your organization.

Conclusion

This objectives matrix can be used with any measures appropriate for your organization. It allows you to quickly determine an overall ranking for your organization for the time period studied. This can allow management to track the organizations performance over time and make recommendations for improvements as needed.

Discussion 10 min

*****Ask the following questions. Encourage as many members of the group to contribute as possible. Let them discuss the issues and arrive at an understanding of these measures.

What type was each measure, process, product or surrogate? Why?

How might a manager use such a combined index?

How would such an index be useful specifically for improvement?

*****Tell them the course is over now. Thank them for their attendance and contributions. Express your hope that they have found it useful.

Appendix D. Meeting Summaries and Notes

This appendix contains the weekly meeting summaries and notes applicable to the case analysis. Each entry has the date of the meeting and a summary of what was accomplished. Each entry then contains the notes of observations made by the researcher of any phenomenon occurring in that meeting of interest to the subject of a performance management framework.

At the conclusion of each entry are some suggestions of subjects that the observations pertain to. These subject suggestions were made as a help to subsequent efforts by the researcher to assimilate the information into a usable framework. The common thoughts from this framework were then compared to the subjects generated in the literature review to obtain consistent conclusions.

These entries follow the meetings required to work through the problem solving routine (process diagram, problem identification, solution proposals, implementation actions, method of measurement) for the Corps of Engineers Design Review process. The team then proceeded to the other processes, but the experiences gained on this first process attacked are sufficient grounds for analysis and conclusions in this case.

Date: 02 Nov 89

Summary of meeting:

This was the initial meeting of the process action team. Training was provided for the group in problem solving techniques and a strategy for generating ideas for improvements. This training was comprised of a rapid synopsis of the Quality & Productivity Team Process Manual (QMT-082), prepared by Professor Virgil Rehg and published by AFIT/LSQ (Rehg, 1988). The training was administered by a representative of the industrial engineering branch of the squadron. This individual explained that in most cases more detailed training is offered to groups, consuming an hour or more of group time before beginning any actual work. In this case the training was limited to twenty minutes. The rational given by the trainer was that the group consisted of scientifically trained and capable people, who could proceed with the tasks with this minimal training.

The team decided on the goal of their efforts in the coming weeks, and set their direction. The team then brainstormed to list the steps in three design review processes: Corps of Engineers, O&M A/E, and O&M In-house.

Notes:

My observation is that the training was too rushed. The procedure and techniques presented were not explained in sufficient detail to be of much use to the group. The group could have benefited from additional time spent in training and orientation.

The team proceeded without difficulty through the process identification. Major steps in the processes were listed. The team was not sidetracked to any degree by discussing the steps. The resulting process flow diagrams will provide a useful framework for problem solving. See Appendix E for these flow diagrams.

Subjects:

Training
Implementation
Process Technique
Engineering Distinctives
Goal of Improvement

Date: 09 Nov 89

Summary of meeting:

The processes diagramed in the previous meeting were reviewed. A forth process, the ASD design, was added and diagramed.

The problems in the Corps of Engineers (COE) Design Review process were brainstormed from the beginning step, designer selected, to the distribute design step.

Notes:

The team identified a number of problems in these steps. Discussion was held to an acceptable minimum. At times potential solutions were obvious and were mentioned along with the problems. The solutions were not discussed in detail, just noted for future reference during the solution phase of the teams work.

Subjects:

Participation
Process Techniques

Date: 30 Nov 89

Summary of meeting:

The team identified problems in the COE process from the collect step through the end 90% review step. The team agreed to go back through the COE process to begin proposing solutions to the problems previously identified from the designer selected through submittal arrives steps. Items were combined as appropriate and prioritized.

Notes:

The team proceeded rapidly through the process. Problem statements were kept short and to the point. Tangential discussions did not occur to detract from the business at hand. Enthusiasm is high, the team is really getting into it. A thorough understanding of the COE process is being obtained through examining the problems.

The work area supervisorho is a member of the team and the boss of all the other members was not present at this meeting. There seemed to be some hesitancy among the members present about which way to proceed or how far to go without the boss present. Encouragement and direction were needed from the facilitator to keep focused.

Subjects:

Participation
Culture change
Facilitator

Date: 07 Dec 89

Summary of meeting:

Discussed the submittal arrives and submittal levels issues. A team member took the action item to check with someone to better understand the MCP timing requirements (driven by when items are required in congress). The team found more problems coming to mind as solutions were discussed. Little headway was made.

A representative of the Air Base Wing Quality Council attended the meeting as an observer.

Notes:

The team found that they did not understand this step in the process. The list of problems brainstormed at an earlier meeting did not begin to cover the scope of difficulties. It was somewhat discouraging to the team to make so little progress, especially after the previous meeting had seen so much accomplished. It seems not enough time was spent wrestling with the problems and encouraging the members to explore them in detail at the earlier meeting. While it was good that the problems came out here, it derailed the solution generation effort.

The team was proud but also seemed to be somewhat intimidated by the Quality Council guest's presence. They showed the guest a lively meeting.

Subjects:

Implementation
Participation
Management Commitment

Date: 04 Jan 90

Summary of meeting:

The team discussed the final problem areas of when the submittal arrives. More involvement in the review process by the COE area office was suggested. The discussion moved to the distribution procedures. Solutions were proposed to the problems previously identified in this step. At this point the discussion got off subject and onto the O&M In-house procedures.

Notes:

The team continued to struggle with an incomplete list of problems from the earlier meetings. Perhaps it is just that at the earlier time the team was not warmed up and was not thinking analytically enough. Time was spent again in this meeting discovering new problems, when the team had previously decided that the problem list was complete and moved onto solutions. Perhaps the scope of this first process for the team was too large and complex. The team perhaps was not prepared for the need to examine their work in detail unlike they were used to.

This was the first meeting back after a four week layoff due to the holidays. The effect of this layoff was that the team was slow to recall where they had gotten to before. They were somewhat slow too in regaining their momentum and analytical thinking. But by the second half of the meeting they were in full swing again. A better review of past accomplishments and an agenda for the current session by the facilitator might have speeded this recovery.

Subjects:

Management Direction - Selection of process
Implementation
Facilitator
Participation

Date: 11 Jan 90

Summary of meeting:

The 2750 Air Base Wing quality day was announced as 29 Jan. The team was invited to a photo session in preparation for that event.

The team brainstormed solutions to the COE problems. The steps addressed were the collect step through the send to HQ step.

A plan to invite a 2750 ABW/COMM representative to the next meeting to discuss "How to justify/request the assignment of a communications engineer to WPAFB" was made.

Notes:

The supervisor of the engineering branch has been directly involved in the process action team meetings, where the remaining participants are all subordinate to this supervisor. The supervisor has been open-minded and non-judgmental. This has seemed to encourage the other participants to speak out freely about problems they face and difficulties they have in solving them. They appear eager to tell the supervisor things he does not know about how bad the situation often is. He in turn frequently expresses disbelief at what his people have had to put up with. This encourages the other participants to speak out even more frankly, seeing that their comments are not falling on deaf ears.

My observation is that the supervisors participation regularly in the team's work has been positive. Information has been brought out in the group meetings which may never have been revealed had not the atmosphere of interest, and willingness to make the changes proposed, been established by the supervisor.

Subjects:

Management Direction - Selection of team

Date: 18 Jan 90

Summary of meeting:

The team arranged for two representatives of the area Corps of Engineers office to attend. Questions were allowed both ways to better understand each others work. Problems that the team had previously identified which dealt with the interface with COE were referred to and discussed.

Notes:

The COE representatives were visibly impressed with the teams work and open-minded attitude. They were put on the spot to answer pointed questions. They too were unsure how the base used some of their input. The result was that a greater understanding of each others problems and reasons for doing things was gained. In addition, mutual respect was increased by seeing the competence of "the other guys". Several agreements were reached to establish better communication and to make changes within the authority level of those present to improve the interface.

This was an important expansion of the process framework by including the agency who is the upstream provider of the design submittals as well as the downstream customer for the base's output of comments. A new appreciation of the scope of the process was attained. It could not have been done without management inviting the representatives.

Subjects:

Process Extension
Implementation
Management Support

Date: 25 Jan 90

Summary of meeting:

Solutions were proposed to problems identified earlier in the 90% complete step of the COE process. The solution phase was completed with this step.

The team agreed to proceed now into the actions to implement the solutions, and who would be responsible for each action. Since management was present in the meeting (one member was the supervisor for the COE process) no further approval by management was needed. Actions were detailed for the solutions in the first step of the process, designer selected.

Some of the implementation actions took the simple form of a letter to an outside agency describing the position of the Engineering Branch on the issues.

Notes:

The team was relieved and encouraged to reach this milestone in the problem solving routine. They had been nearly two months on the solution phase. Finally it was starting to come together. The team chose not to address the measurement techniques for the actions at this time. Getting the actions detailed and assigned was enough. Measurement would follow.

The sometimes fuzzy ideas which had been the solutions began to make much more sense when converted into actions for implementation.

Subjects:

Management Support - Implementation
Measurement
Implementation
Participation

Date: 01 Feb 90

Summary of meeting:

The contents of the letters to the COE describing the Engineering Branch's position on issues were reviewed. Implementation plans for the submittal arrives step were begun. A member of the team was assigned the task of establishing a plan room for review. This was an action considered to be worthy of immediate implementation.

Notes:

The team was thrilled to recommend the plan room for immediate implementation. It was a concrete example that their efforts did make a difference.

The primary facilitator for the process action team observed in this research had no formal training as a facilitator. A trained facilitator, a member of the industrial engineering branch, attended most of the meetings in an advisory capacity. This person answered questions which were raised about techniques and procedures for the team's operations. However, the conduct of the team meetings themselves were left to the untrained primary facilitator. The purpose of this assignment was to afford experience for this individual to "learn on the job" how to facilitate a group.

My observation is that this did not seriously injure the ability of the group to operate effectively. The group consisted of technically and scientifically trained people, aware of problem solving techniques. They did not appear to need much guidance.

On the other hand, the format of the meetings was quite predictable and routine. Could a trained facilitator have provided variety and innovative methods for generating interaction and information? Would such methods have led to better performance by the group? Or, were the results accomplished as good as any which may have been achieved through other techniques?

Subjects:

Facilitators
Implementation
Participation

Date: 08 Feb 90

Summary of meeting:

The subject of the plan room location was discussed. The team decided to put the decision on hold until management of the Engineering Branch can gather more information.

The team was informed of a memo from a staff engineer from the Operations and Maintenance Branch regarding their review process.

Actions to implement solutions from the submittal arrives step were determined and assigned.

Notes:

The team is not afraid to assign implementation actions to other responsible individuals within the organization. While many of the actions are accepted by team members, others are assigned out. Having the management supervisor present assures that these items will not be forgotten.

Another important milestone was realized by further extending the process to the Operations and Maintenance customer interface. By receiving the memo, the team came to a greater understanding of their process. This also showed that the team's work was having an effect throughout the organization; others were feeling inclined to become a part. The team recognized the time had come to start publicizing some of their accomplishments.

Subjects:

Management Support - Implementation
Culture Change
Implementation

Date: 15 Feb 90

Summary of meeting:

Actions to implement solutions for the distribute step in the COE process were detailed. In particular, a new procedure for managing COE designs was beginning to emerge. The team detailed these new steps and realized they were creating a new position description for a person to manage Corps of Engineers projects.

A guest attended the team meeting for the third week in a row. The guest was a member of one of the sections in the Engineering Branch.

Notes·

The maturity and flexibility of the team was demonstrated at this point by their acceptance of a new attendee at their meetings. No one appeared to feel threatened, and the guest's input was listened to and accepted.

This guest came uninvited, apparently hearing of the accomplishments of the team and wanting to be a part. This is testimony of the interest the team was beginning to develop by this time.

Many of the actions detailed for implementation covered a variety of the solution ideas which were brainstormed earlier in the problem solving routine. The linkage of these actions with the solutions they implemented was kept, so that a statement could be made to management regarding what actions implemented which solutions and ultimately which problems were the cause.

Subjects:

Participation
Culture Change
Measurement - Sell Management

Date: 22 Feb 90

Summary of meeting:

The detailing of actions to implement solutions to problems in the COE process was completed, with the steps of collect through 90% review being discussed.

Notes:

At times the feathers started flying as implementation actions proposed hit close to home and the members present tried to justify their past way of doing things and began to wonder what the actions proposed might require and how well they might work. A peacekeeping role by the facilitator was required to soothe these worries and get the meeting back on track and off the arguments.

Everyone breathed a sigh of relief as the implementation action phase of the problem solving routine was completed. And with it was an appreciation for all that had been accomplished.

Subjects:

Participation
Facilitator

Date: 01 Mar 90

Summary of meeting:

A summary list of the processes, problems, solutions, and implementation actions was distributed. The list was reviewed. The list was evaluated in light of a recent announcement that with the breakup of the AFRCE function, a new COE Milcon Execution Plan will be developed. This means some of the exact implementation actions are no longer useful because they were designed to change the old system. However, it was pointed out that the work of the team will make a fine foundation to the preparation of the new Execution plan.

Notes:

Instead of changing the old system, the work of the team could now be used to build a new system. This was something of a mixed blessing. Having just created their implementation actions, the team would have been encouraged to see them put into effect and make the changes. So there was some disappointment. However, as the weight of the opportunity to build the new system from scratch sunk in, the team could recognize the significant steps already taken to make sure the new plan worked better than the old.

Subjects:

Management Direction
Participation

Date: 08 Mar 90

Summary of meeting:

The team brainstormed measures of success for the actions they had previously proposed. Individual action measures were determined, and how to gather the information discussed. In addition, an overall goal measure of reducing change orders was proposed as the bottom line gauge of success.

Notes:

The overall goal and measure of success came up here, at the end of the problem solving routine. It might have been more effective to have been established from the beginning, so that the team would have been constantly aiming at it.

With the measures established, and the responsibility for implementations assigned in the previous phase, the problem solving routine was complete for the Corps of Engineers design review process.

Subjects:

Measurement
Implementation
Goal of Improvement

Appendix E. Process Flow Diagrams

Corps of Engineers

Designer Selected
Contract Set

Submittal Arrives
(10%),30%,(60%),90%

Distribute Per List

Collect, Compile, Filter Comments

Send to Headquarters
Design Review Meeting

Repeat from "Submittal Arrives" Until
90% Submittal Level Is Reached

End

Figure 35. Corps of Engineers Design Review Process

O & M Architect/Engineer

Designer Selected
Contract Set

Assign Task

Submittal Arrives
10%,35%,90%,100%

Distribute Per List

Collect, Compile, Filter Comments

Send to Architect/Engineer
Design Review Meeting

Repeat from "Submittal Arrives" Until
100% Submittal Level Is Reached

90% Pre-final Review Distribution by DEEE

End

Figure 36. O & M Architect/Engineer Design Review Process

O & M In-House

Designer or Team Selected

Prepare 35% Cost Estimate
Compare to Programmed Amount

If Cost Unacceptable, Reprogram

90% Pre-final Review Distribution by DEEE

Compile Comments

Forward to Engineer to Use or Respond To

End

Figure 37. O & M In-house Design Review Process

ASD Architect/Engineer

Submittal Arrives

Distribute Per List

Collect, Compile, Filter Comments

Send to ASD

Repeat from "Submittal Arrives" Until 95% Submittal Level Is Reached

Receive AFLC 95% Comments

Receive Complete Documents for Contracting

End

Figure 38. ASD Architect/Engineer Design Review Process

Appendix F. Design Review Process Problems, Solutions, Actions, and Measures

This appendix contains a summary of the brainstorming sessions of the performance improvement team as they studied the design review process. The team first identified the problems in each step of the Corps of Engineers design review process. They then proposed solutions to these problems. Finally, actions were recommended to implement these solutions and measures of success proposed.

The steps in the Corps of Engineers design review process, together with three other processes the team identified, are outlined in Appendix E. For ease of reference, the problems, solutions, actions, and measures are consolidated for each step of the process. This allows the reader to see how the problems in a step were solved. However, the procedure the team followed to generate this information was not as shown. Rather, the team first identified problems in all of the Corps of Engineers process steps together. Next solutions were proposed to all the problems in the entire process. Actions were then detailed to implement the solutions. Finally, measures were proposed to track the actions.

As of: 14 Mar 90

DESIGN REVIEW PROCESS "PAT"

Corp-of-Engineer (COE) Design Review

I. Designer Selection Step

A. Problem Areas

1. Since no input requested from base, get stuck with A-E (sometimes bad).

2. AE selected from Cincinnati/Kentucky, too far.

B. Solutions

1. Input from base

a. Get someone on committee (TDY).
b. Get to review candidates or make recommendations.

c. Provide comments from previous AE designs.
d.. Learn the COE selections process.
e. If COE selection procedure includes location factor, use WPAFB as optimal location, not Louisville. If not, have them include it.
f. Contract requires ample site visits by A-E for predesign verification.

C. Implementation Actions

1. In letter 1 to HQ AFLC with a copy to COE:
a. Request support for a base representative to attend final selection committee and participate as a voting member. Member will communicate base evaluation of A-E's to selection committee.

b. Request that COE be instructed to notify base of top candidates from A-E pre selection committee when known.

2. Include in OI for DEEED project mgrs.:

a. To bring base evaluation of A-E's to final selection committee for briefing.

b. When design instruction is issued, project manager will send letter 3 to COE and all reviewing agencies, informing of base CE POC.

NOTE: Above actions superceded by the MILCON Project Management Plan (MPMP). WPAFB will correct this problem area by participating in the development and implementation of the MPMP.

OPR: DEEP ECD: Set by MAJCOM

3. Budget funds for project managers to attend final selection committee.

OPR: DEE ECD: Each 01 Oct

D. Measuring Progress/Success.

1. Percent of Final Selection Committee meetings attended each FY with a goal of 100%.

OPR: DEEED for tracking goal percent ECD: Ongoing

II. Submittal Arrives Process Step:

A. Problem Areas

1. Routed through COE, time is lost.

2. Not enough copies.

3. Don't see project after 95% comments.

4. Submittal levels may not be appropriate (ie: 10% for scope, 90% for tech review, are 30% and 60% needed)

5. Too many separate voices giving direction to AE.

6. AE relies on us for QC and to catch mistakes which slows down submittal timing requirements.

7. COE const. representative on-base is not active enough in design review.

B. Solutions

1. Include survey notes in early submittal, and other predesign investigation info (soil logs, utilities)

2. In lieu of current 35% submittal, request a 10% submittal to include such as structural, electrical, mechanical systems, suggested floor plan, and site plan, and site investigation results.

3. Changed to 20%, not at 50%. Clearly outline what's required to get uniformity. 10% could be presentation with alternatives.

4. Get more dollars released for 1st submittal.

5. 60% added by COE as needed for large projects.

6. 10, 35, 90% submittals are needed and need to be well defined (checklist).

7. 100% needed before contracting starts to make last check of comments.

8. Number of copies/route through COE.

9. Decide how many needed and get into DI (5).

10. Establish consistent distribution channel.

11. Locate plan review room that is a consistent place, that can be reserved for 1-2 days. Everyone has their own place now.

12. Be informed of overall design schedule. Have it included in submittal from A-E.

13. For 100% submittal, get on distribution list with time to comment before contract start.

14. Have drawing control log on cover sheet of drawings showing who should get review sets.

15. Since too many voices, minimize list of people who see submittals to review. All comments should go through COE project manager as lone voice to A-E.

16. Need opportunity to discuss and defend comments, prior to project manager and deleting.

17. Instruct A-E to go back and arbitrate deleted comments.

18. Have mandatory design review meeting where deleted comments are identified and discussed.

19. A-E using AF for QC

a. Get tough with A-E.
Hold responsible for their mistakes.

b. Return inferior submittals without review and demand reworked submittal.

c. Withhold payment for inferior submittals.

d. Make sure A-E is given adequate time to design, so they have time to do job right.

20. COE design rep on base.

a. COE develop position (deputy?) to be responsible for design review on base.

b. Have COE design engineer assigned to base for project duration during construction (especially when AFRCE dissolved).

C. Implementations Actions

1. Send letter 2 to COE, copy to AFRCE

a. Detail what base wants to see in submittals, particularly evidence of site investigation (survey notes, etc.) in early submittals. Send submittal requirement description from O&M projects.

b. Emphasize to COE need for extensive early design work.

c. Inform COE of new procedure for base to send letter 3.

d. Ask that COE have design schedule included in first submittal by A-E.

e. Ask that COE have A-E include distribution list for review sets on cover sheet.

f. Ask that COE send copy of 100% submittal to base immediately upon receipt from A-E for base to check critical items.

2. In letter 3, base project mgr will detail what submittals are desired for the project. Include this in O.I.

3. Submit work requests for plan room.

OPR: DEE ECD: 01 Mar 90

4. Letter 3 is to include an invitation to reviewing agencies such as user, EM, Comm, DEF, DEM, Safety, DEEC, etc., to comment to DEEED PM. Include this in O.I.

OPR: ECD:

5. Inform COE in letter 2 that base needs design review meeting on each project for chance to defend base comment which HQ AFLC or AFRCE have deleted, at 60% or 90% as a minimum as appropriate

OlR: ECD:

6. Include in DEEED Project Mgr O.I.:

a. PM to keep track of comments made from base, and resolve conflicts or elevate to higher authority as needed to get results.

b. PM to inspect each newly received submittal for completeness against requirements for submittal level. If deficient, a letter will be sent to HQ AFLC complaining, and suggesting payment be withheld.

NOTE: Except for action 3, all of the above actions will be satisfied through the development and implementation of the MPMP. Item 1.f. can be deleted.

OPR: ECD:

7. In letter 2, request COE assign design rep to base.

NOTE: Delete, since this will be addressed when the AFRCE is disbanded.

III. Distribute Design Documents/Drawings Step

A. Problem Areas

1. Are the right people on the list? (ie: make sure COE const. staff included).

2. User gets design package last.

3. Personnel changes at user, changes scope.

4. Local COE office comments only at 90%.

B. Solutions

1. Create design review position in DEEC (Right people on list?)

2. Have yearly review by mgt of who is on list and update accordingly.

3. Have design review room and send letters to review if interested.

4. Include DEE and DEEE for comments.

5. Develop user design checklist to make sure consideration is given (CID, disruption, equipment by user, scope, get copies from A-E's).

6. Add checklist to user review letter.

7. To compensate for user personnel changes and scope change, establish consistent POC at other agencies for review.

8. Insure programming/1391 is complete and up-to-date.

C. Implementation Actions

1. Add DEE and DEEE to distribution list for review. Combine current DEEE and DEEED distribution lists. Submit revised list to the PAT for review.

OPR: DEEE ECD: 01 Apr 90

2. Add to DEEE O.I. and DEEED O.I.:

a. All project review to be distributed from and monitored by DEEE. DEEED will pass submittals to DEEE to place in plan room and send letters to reviewing agencies. DEEE to add user review checklist to letter going to user.

OPR: DEEED ECD: 15 Apr 90

3. Develop user review checklist, to prompt them what to look for, scope, phasing, operations and maintenance, C.I.D. For at least, the initial go-around, request that users provide checklist evaluation/improvement comments.

OPR: DEEED ECD: 15 Apr 90

4. In letter 3, ask all reviewing agencies to identify their POC and alternate. Attach Form 1391 for project to letter to alert reviewers to scope of project. Add this to O.I. for DEEED PM.

NOTE: Incorporate implementation action 4 above in MPMP.

D. Measuring Progress

1. For implementation actions C.2 and C.3 above, evaluate checklist comments provided by users. Incorporate improvements as feasible.

IV. Collect, Compile, Filter Step

A. Problem Areas

1. Sometimes send comments after suspense.

2. Some base comments deleted by HQ with no feedback or explanation.

3. No DEEC reviewer assigned; inspector not assigned until contract start.

4. COMM organization comments normally late.

5. COMM engineering at Griffis (485 EIG) not giving adequate support, so wiring/splicing not getting into contract.

6. DEM review of elec, HVAC, etc. not getting to staff engineers (focal point).

B. Solutions

1. Since base comments deleted at HQ, make a ruling that comments cannot be rejected w/o contacting commentor.

2. Ensure that every COE review has review meeting where deleted comments can be defended.

3. Since COMM design occurs at Griffiss AFB, - need to get Griffiss involved in timely manner.

4. Get COMM engineer assigned to base COMM. or get COMM engineer in DEE to preclude late actions/comments.

5. Since comments sent after suspense, need a design review meeting and review room/area.

6. To get DEEC inspector/reviewer involved from the start, send design to DEEC for review of each step.

7. Assign DEEC person to project for review and follow on construction at start of the project.

8. For DEM review, send directly to staff engineers.

9. Make sure staff engineers are coordinating with shops for comments (suggest they have review meeting with shop personnel).

10. For EM review - understand and communicate their organization and develop workable procedure to get review.

C. Implementations Actions

1. Send letter 4 to 2046 Comm: Current system isn't working. Suggest getting, Comm design engineer assigned to base. Alternate plan to get Comm engr. in base DE for design.

NOTE: Include in letter that the 2046 needs to respond to decentralization resulting from the implementation of the MPMP. Now the base has an even greater responsibility.

OPR: DEEC ECD: Subject to FY92 MCP

2. Make sure review letters to DEM are routed to Staff Engineer Office.

OPR: DEEE ECD: 01 Apr 90

3. Send memo to DEM, informing them that all future reviews will come to staff engineers. Suggest that they have review meeting with shops. They may invite DEEED representative to attend if desired.

OPR: DEEED ECD: 01 Mar 90

4. Obtain new wing and base CE organizational charts, including EM under DE, and phone lists for EM.

OPR: DEEE ECD: Done

5. Set up session between all EM branch chiefs and DEE section chiefs to formalize processes for permitting, etc. Show them flow chart of review processes developed in PAT.

OPR: DEE ECD: 15 Mar 90

D. Measuring Progress

1. For implementation action C.2 above, evaluate process at the end of FY 90 to determine if review of the design package by the Staff Engineer's Office has improved and that shop comments are included in the final review. Also, conduct a random survey of the shops to determine if they has an opportunity to review the design package and provide comments.

OPR: Project Manager for the random survey and DEEED for adding to the Design Process O.I. ECD: Depends on FY92 MCP

2. For C.5 above, success will be a measure of having a productive meeting with EMO.

V. Design Review Meeting

A. Problem Areas

1. HQ filters comments without meeting with base before HQs sends comments to COE/AFRCE.

2. Do not have design review meetings on every project.

3. Do not conduct scope focused review meetings at 10% or 30%.

4. COMM representatives are only good for technical questions. Have no authority.

5. DEEC not notified.

6. Design rep. and construction rep not identified in MCP report.

B. Solutions

1. Have HQ instruct COE to include in contract provision for all meetings at WPAFB.

C. Implementation Actions

1. In letter 1 to HQ AFLC, request all design review meetings be conducted at WPAFB.

OPR: ECD:

NOTE: Include in MPMP development and implementation.

VI. Scope Review at 90%

A. Problem Areas

1. Never see 100% for checking comments.

2. Since no continuity in review among user & COMM, different folks looking at each submittal, or command/personnel changes.

B. Solutions

1. Make sure user, AFRCE, A-E, DEEP are involved at 10% or 30%.

2. Identify DEEC rep on MCP Report from outset.

3. Discussed 100% design review with COE during 18 Jan 1990 meeting at Wright-Patterson AFB. They do not send out for new review, unless the project sits on the shelf; then sent to the AFRCE. Therefore, have the COE send the 100% for a Base check for each project.

4. Need Base Comm./user continuity when conducting design review.

a. Assign a single point of contact (POC) within these organizations. Have POC attend design review meetings.

b. When the Design Instruction is issued, the project manager should establish the POCs.

c. Make certain that each organization has an alternate/backup; someone who can continue the process if the primary is unavailable.

C. Implementation Actions

1. Include DEEC rep and DEEED rep for each COE project on MCP report, all reports.

OPR: DEEP ECD: 20 Mar 90

2. In letter 1 to HQ AFLC, request that COE not be permitted to send projects out to bid if they haven't been reviewed by the base in the last 6 months.

3. In letter 4 to 2046 Comm, inform them of the new review procedure adopted, and that at the outset of each project they will be asked for a primary and alternate P.O.C.

NOTE: Include actions 2 and 3 in the development of the MPMP.

OPR: ECD: Contingent on FY92 MCP

D. Measuring Progress

1. For C.1 above, action will be considered successful when the next MCP Report is issued.

E. Overall Measure of Progress/Success

1. Minimize Change Orders

a. Establish a baseline for the last five (5) years, FY85-89 to include by project change orders required by (1) design errors (2) design omissions (3) mission/user changes and (4) latent conditions.

b. Measure change orders as a percentage of the contract price.

c. Goal is to reduce change orders caused by (1) and (2) to zero (0) and reduce (4) by improved site investigation.

Items From Visit By Corp-of-Engineers (COE) Reps

1) Vehicle exists to include base input in selection, now evidently just getting to AFRCE.

2) COE to BCE communication gets lost at AFRCE. Base doesn't hear about selection/pre-design meetings. Have COE contact base directly.

3) Add discussion of upcoming project status to monthly COE meeting at base. Have base design rep. attend.

4) Establish procedure design support unit and COE for early coordination on D.I.'s, selection and pre-design.

5) Get copy of COE book detailing what each submittal is composed of.

6) AF can choose what submittals it wants (10%, 60% are extra).

7) Can't change 35% requirements, except maybe on a specific item.

8) A-E only held responsible for design errors if: 1) No damage to gov't 2) Gov't didn't mislead A-E with incorrect dwgs. A-E is responsible for damages and to redesign the solution. Performance reflects on ACASS evaluation rating.

9) A-E not payed for extra submittals when caused by A-E's poor work.

10) Base COE members have various design duties, but no specific member assigned exclusively for design problems.

11) 100% is checked internally and constructability review made before RTA and put on street.

12) COE issues amendments during bidding to answer questions, so BASE can get final comments to COE for inclusion in amendment.

13) See if base can tie into ACASS network.

Appendix G. Quality Questionnaire

The following sections will ask for information . from you about your organization. Please answer each question to the best of your abilities on a separate sheet of paper. For example, the primary intention for the following section on leadership is to determine if your organization's leadership emphasizes quality as part of the company's value system, through both personal action and through demands on employees. Use the following scale to rate all questions.

1 = Strongly disagree
2 = Moderately disagee
3 = Slightly disagree
4 = Neither agree nor disagree
5 = Slightly agree
6 = Moderately agree
7 = Strongly agree

PREFACE: The intent of this questionnaire is to query individuals who have been intimately involved with the CE PATs and those who have not, then to note significant differences. Please indicate on your separate answer sheet if you have or have not been intimately involved with the PATs in Civil Engineering. Any information regarding your experiences in your organization's quality movement, if any, would be appreciated.

I. LEADERSHIP

A. Supervisory Communication

1. Your supervisor encourages you to let him/her know when things go wrong on the job.
2. The communication between you and your supervisor is good.
3. You are free to tell your supervisor that you disagree with him/her.
4. Work center problems are often discussed as a group, with supervisors and workers openly and honestly discussing the issues.
5. Your supervisor is fully aware of work center problems.

B. Participative Decision Making

1. This organization is always moving toward the development of new answers.

2. In your organization, people are allowed to try to solve the same problem in different ways.

3. Creativity is encouraged in your organization.

4. People in your organization are always searching for fresh, new ways of looking at problems.

5. The leadership acts as if people in your organization are creative.

C. Commitment to Quality

1. Quality is more than just the latest fashionable "buzzword".

2. Your boss is sincerely interested in giving you time to do the job right.

3. Product defects are an unwanted, but inevitable by-product of deadlines and schedules.

4. Your supervisor tries hard to remove restrictions that limit performance.

D. Shared Vision

1. Continually improving work results are a realistic goal.

2. Our organization continually works to improve overall end results.

3. When we work to increase quality, we don't necessarily decrease productivity.

II. STRATEGIC QUALITY PLANNING

A. Goal Clarity

1. You know exactly what is expected of you in performing your job.

2. You understand the priorities associated with what you are expected to accomplish on the job.

3. Your supervisor clearly indentifies those work processes that need improvement.

B. Goal Congruence

1. Your organization's goals make a lot of sense.

2. You have a personal stake in your organization's effectiveness.

III. HUMAN RESOURCE MANAGEMENT

A. Training Adequacy

1. You have all the skills you need in order to do your job.

2. You have been provided enough training to acquire the necessary skills to do your job well.

B. Involvement

1. You feel personally responsible for the work you do on your job.

2. You often make suggestions for improving work conditions and processes.

3. Management encourages, and often discusses with the work force new ideas for improving how jobs are done.

C. Empowerment

1. Rules and regulations of your organization are not meant to hinder your performance.

2. Your ideas for improving work conditions and processes are often implemented.

3. You are given opportunities to provide your own ideas to try to improve "the way things are done" in your organization.

D. Expectancy

1. Your supervisor consistently rewards top performers.

2. The people who most deserve recognition receive that recognition.

E. Role Clarity

1. You know exactly what is expected prior to undertaking any specific task.

2. You know who makes the decisions in your organization and how the decisions are reached.

F. Recognition/Feedback

1. Your least frequent feedback is criticism.

2. Your supervisor provides immediate feedback when work results are good.

3. You usually know whether or not your work is satisfactory.

IV. QUALITY ASSURANCE OF PRODUCTS AND SERVICES

A. Quality system

1. You have no problem obtaining the tools, equipment and supplies necessary to do your job.

2. You are held accountable for your mistakes and are required to take action to prevent their recurrence.

3. This organization attempts to solve its problems as best it can.

V. QUALITY RESULTS

A. External Measures

1. Your organization is as good as any other similar organization.

2. Complaints are rarely ever received about the work of your organization.

3. The results of work in your organization meet your customers standards.

B. Internal Measures

1. Your organization is the best it has ever been.

2. In your organization everyone knows how important it is to do things right

VI. CUSTOMER SATISFACTION

A. Responsiveness

1. Your customers have the right to call and talk to the person who did the work if they are unhappy about it.

2. If a customer complains about something, immediate action is taken to identify the problem.

3. Customer satisfaction is the whole reason we work for-the phrase "satisfying our customers" receives more than just "lip service" in our organization.

4. Customers are given the fastest possible feedback to their questions.

5. It is easy for the customer to get in contact with the experts.

6. Customers receive courteous treatment from your organization.

B. Feedback

1. The most important measures of your performance are obtained through customer feedback.

2. You always receive information on our customers reactions when it involves your work.

3. In this organization, you often make changes based on inputs from your customers.

Thank you for your help in this endeavor.

If you have any constructive comments regarding improvement of your quality program, please indicate these for consideration by your organization.

Appendix H. Survey Data

Question	Treatment Group Pre-Test Member 1	Member 2	Member 3	Member 4	Member 5
1	7	7	5	7	7
2	7	7	6	7	7
3	7	7	6	7	7
4	6	5	3	5	7
5	6	6	5	5	7
6	5	1	3	5	7
7	5	6	6	4	7
8	6	2	4	5	7
9	6	3	2	7	6
10	5	1	2	4	7
11	5	3	4	4	7
12	4	7	6	7	7
13	7	3	7	5	6
14	6	7	5	7	7
15	4	7	5	7	7
16	5	3	3	6	7
17	7	4	4	6	6
I.	86	73	65	89	103
18	6	6	6	7	7
19	5	6	4	7	7
20	6	7	4	7	7
21	2	4	5	4	6
22	5	6	7	6	7
II.	24	29	26	31	34
23	5	5	2	7	6
24	7	2	2	7	6
25	7	7	7	7	7
26	7	7	5	5	7
27	6	2	3	4	7
28	5	4	6	2	7
29	5	5	6	6	7
30	7	5	6	6	7
31	6	6	5	7	7
32	6	2	4	7	7
33	5	6	4	7	7
34	7	6	3	6	7
35	5	3	3	2	7
36	4	6	4	2	7
37	7	6	4	3	7
III.	89	72	64	78	103

Question	Member 1	Member 2	Member 3	Member 4	Member 5
38	2	1	2	3	6
39	4	4	4	7	7
40	4	3	6	7	7
IV.	10	8	12	17	20
41	7	4	4	4	7
42	3	2	1	4	6
43	3	3	3	4	7
44	4	5	1	6	7
45	3	3	6	6	7
V.	16	12	14	18	27
46	3	4	7	4	7
47	3	3	4	4	6
48	3	3	4	3	7
49	3	3	2	5	7
50	2	5	2	5	7
51	3	4	5	4	7
52	3	7	5	1	6
53	4	1	4	1	6
54	5	2	7	4	6
VI.	29	32	40	31	59
Total	254	226	221	264	346

Question	Treatment Group Post-Test Member 1	Member 2	Member 3	Member 4	Member 5
1	7	7	5	4	7
2	7	7	6	4	7
3	7	7	6	2	6
4	5	5	4	3	5
5	5	6	5	5	6
6	5	3	4	5	6
7	6	3	4	5	6
8	6	1	4	6	6
9	5	2	3	6	5
10	5	1	4	3	6
11	5	3	4	2	6
12	5	6	6	6	7
13	5	7	7	6	5
14	7	6	5	6	6
15	7	3	5	5	7
16	7	3	3	4	6
17	7	5	4	3	6
I.	91	65	68	67	92
18	6	6	5	3	7
19	7	5	3	4	7
20	6	7	4	3	7
21	5	2	4	2	5
22	5	6	7	2	7
II.	29	26	23	14	33
23	5	3	3	6	5
24	5	1	2	6	5
25	7	7	7	6	7
26	7	7	5	2	6
27	7	5	3	3	5
28	5	4	4	1	5
29	5	6	4	4	6
30	6	6	4	4	6
31	6	6	4	4	7
32	6	3	5	3	6
33	7	6	5	6	6
34	6	7	4	3	7
35	5	6	3	5	6
36	6	6	4	5	7
37	7	6	5	6	7
III.	90	79	62	64	91

Question	Treatment Group Post-Test Member 1	Member 2	Member 3	Member 4	Member 5
38	5	5	2	1	6
39	5	5	6	5	7
40	6	2	3	7	7
IV.	16	12	11	13	20
41	7	6	4	4	7
42	5	2	2	3	6
43	5	3	4	4	6
44	7	5	4	6	6
45	5	3	5	6	6
V.	22	14	15	17	25
46	7	5	6	7	6
47	6	5	6	7	6
48	5	3	5	6	6
49	5	3	5	6	6
50	6	6	6	7	6
51	5	6	6	7	6
52	4	2	7	2	5
53	4	1	6	2	5
54	5	6	7	5	5
VI.	47	37	54	49	51
Total	295	233	233	224	312

Question	Control Group Pre-Test Member 1	Member 2	Member 3	Member 4
1	7	4	7	7
2	7	5	7	7
3	7	5	7	7
4	6	2	6	6
5	7	5	6	6
6	7	3	6	6
7	6	5	6	5
8	7	5	6	6
9	6	4	6	5
10	5	3	6	5
11		2	6	5
12	6	5	6	6
13		7	1	4
14	6	4	6	6
15	7	5	6	5
16	6	2	6	6
17	7	4	7	6
I.	97	61	94	89
18	7	6	7	6
19	7	6	7	6
20	7	4	6	6
21	6	2	6	4
22	7	5	6	5
II.	34	23	32	27
23	6	6	7	3
24	3	3	7	3
25	7	5	7	7
26	7	5	5	5
27	7	2	6	5
28	7	5	7	6
29	6	6	5	5
30	7	5	6	6
31	7	5	5	6
32	7	6	5	6
33	6	5	7	5
34	6	6	5	6
35	6	5	6	5
36	5	3	6	6
37	7	4	6	5
III.	94	71	90	79

Question	Member 1	Member 2	Member 3	Member 4
38	4	1	5	5
39	6	5	7	6
40	5	5	6	6
IV.	15	11	18	17
41	6	6	6	6
42	7	4	6	4
43	6	3	7	5
44	5	3		4
45	7	3	7	4
V.	26	16	26	19
46	7	2	7	6
47	7	5	6	5
48	7	1	6	5
49	6	5	7	5
50	7	3	6	5
51	7	5	7	5
52	6	6	7	5
53	5	5	6	4
54	4	5	6	4
VI.	56	37	58	44
Total	322	219	318	275

Question	Control Group Post-Test Member 1	Member 2	Member 3	Member 4
1	7	6	7	7
2	5	7	7	7
3	7	6	7	7
4	6	5	7	6
5	5	5	6	6
6	6	4	4	5
7	7	5	6	6
8	7	3	6	6
9	7	5	6	5
10	6	3	6	5
11	7	2	6	4
12	7	5	7	6
13	5	7	1	4
14	6	4	6	6
15	7	5	7	5
16	6	6	7	6
17	6	3	7	6
I.	95	72	96	89
18	7	5	7	6
19	6	6	7	6
20	5	4	7	6
21	6	5	7	4
22	7	5	6	6
II.	31	25	34	28
23	1	4	7	3
24	1	3	7	4
25	7	6	7	7
26	5	5	6	6
27	4	4	7	6
28	7	5	7	6
29	5	5	7	6
30	6	5	7	6
31	7	5	4	6
32	7	6	4	6
33	5	6	7	6
34	4	5	7	5
35	5	5	7	5
36	5	6	7	6
37	7	6	7	6
III.	76	76	98	84

Question	Member 1	Member 2	Member 3	Member 4
38	5	2	6	2
39	7	5	7	6
40	7	4	7	5
IV.	19	11	20	13
41	7	7	7	6
42	5	5	7	3
43	4	5	7	4
44	4	5	4	6
45	5	6	7	5
V.	21	23	28	18
46	7	6	7	6
47	7	5	7	4
48	6	5	7	3
49	7	4	7	3
50	7	4	7	5
51	7	5	7	6
52	5	3	6	3
53	6	4	6	3
54	6	3	6	3
VI.	58	39	60	36
Total	300	246	336	268

Appendix I. Comparison of Group Pre-Test Results

Question	Treatment Average	Control Average	t	tcrit	Result
1	6.6	6.25	0.499991	2.36	same
2	6.8	6.5	0.696009	2.36	same
3	6.8	6.5	0.696009	2.36	same
4	5.2	5	0.196957	2.36	same
5	5.8	6	-0.40788	2.36	same
6	4.2	5.5	-1.06016	2.36	same
7	5.6	5.5	0.177993	2.36	same
8	4.8	6	-1.29582	2.36	same
9	4.8	5.25	-0.42917	2.36	same
10	3.8	4.75	-0.80244	2.36	same
11	4.6	4.333333	0.246765	2.45	same
12	6.2	5.75	0.724418	2.36	same
13	5.6	4	1.172197	2.45	same
14	6.4	5.5	1.6185	2.36	same
15	6	5.75	0.338948	2.36	same
16	4.8	5	-0.17983	2.36	same
17	5.4	6	-0.73879	2.36	same
I.	83.2	85.25	-0.22359	2.36	same
18	6.4	6.5	-0.30161	2.36	same
19	5.8	6.5	-1.10967	2.36	same
20	6.2	5.75	0.591526	2.36	same
21	4.2	4.5	-0.30259	2.36	same
22	6.2	5.75	0.855647	2.36	same
II.	28.8	29	-0.07671	2.36	same
23	5	5.5	-0.46546	2.36	same
24	4.8	4	0.571887	2.36	same
25	7	6.5	1.314684	2.36	same
26	6.2	5.5	1.118748	2.36	same
27	4.4	5	-0.48045	2.36	same
28	4.8	6.25	-1.53378	2.36	same
29	5.8	5.5	0.684271	2.36	same
30	6.2	6	0.407884	2.36	same
31	6.2	5.75	0.855647	2.36	same
32	5.2	6	-0.77583	2.36	same
33	5.8	5.75	0.071996	2.36	same
34	5.8	5.75	0.065007	2.36	same
35	4	5.5	-1.60718	2.36	same
36	4.6	5	-0.38651	2.36	same
37	5.4	5.5	-0.10426	2.36	same
III.	81.2	83.5	-0.28857	2.36	same

Question	Treatment Average	Control Average	t	tcrit	Result
38	2.8	3.75	-0.83987	2.36	same
39	5.2	6	-0.99086	2.36	same
40	5.4	5.5	-0.11728	2.36	same
IV.	13.4	15.25	-0.72631	2.36	same
41	5.2	6	-1.07344	2.36	same
42	3.2	5.25	-1.96662	2.36	same
43	4	5.25	-1.22631	2.36	same
44	4.6	4	0.470523	2.45	same
45	5	5.25	-0.21639	2.36	same
V.	17.4	21.75	-1.33273	2.36	same
46	5	5.5	-0.40296	2.36	same
47	4	5.75	-2.63475	2.36	changed
48	4	4.75	-0.58969	2.36	same
49	4	5.75	-1.79034	2.36	same
50	4.2	5.25	-0.891	2.36	same
51	4.6	6	-1.7155	2.36	same
52	4.4	6	-1.40896	2.36	same
53	3.2	5	-1.74561	2.36	same
54	4.8	4.75	0.052889	2.36	same
VI.	38.2	48.75	-1.55862	2.36	same
Total	262.2	283.5	-0.72956	2.36	same

Appendix J. Comparison of Group Pre-Test Variance

Question	Treatment Variance	Control Variance	Pooled Variance	f	fCrit	Result
1	0.64	1.6875	1.088929	2.636719	6.59	same
2	0.16	0.75	0.412857	4.6875	6.59	same
3	0.16	0.75	0.412857	4.6875	6.59	same
4	1.76	3	2.291429	1.704545	6.59	same
5	0.56	0.5	0.534286	1.12	9.12	same
6	4.16	2.25	3.341429	1.848889	9.12	same
7	1.04	0.25	0.701429	4.16	9.12	same
8	2.96	0.5	1.905714	5.92	9.12	same
9	3.76	0.6875	2.443214	5.469091	9.12	same
10	4.56	1.1875	3.114643	3.84	9.12	same
11	1.84	2.888889	2.18963	1.570048	6.94	same
12	1.36	0.1875	0.8575	7.253333	9.12	same
13	2.24	6	3.493333	2.678571	6.94	same
14	0.64	0.75	0.687143	1.171875	6.59	same
15	1.6	0.6875	1.208929	2.327273	9.12	same
16	2.56	3	2.748571	1.171875	6.59	same
17	1.44	1.5	1.465714	1.041667	6.59	same
I.	173.76	204.1875	186.8004	1.175112	6.59	same
18	0.24	0.25	0.244286	1.041667	6.59	same
19	1.36	0.25	0.884286	5.44	9.12	same
20	1.36	1.1875	1.286071	1.145263	9.12	same
21	1.76	2.75	2.184286	1.5625	6.59	same
22	0.56	0.6875	0.614643	1.227679	6.59	same
				ERR	6.59	ERR
II.	12.56	18.5	15.10571	1.47293	6.59	same
23	2.8	2.25	2.564286	1.244444	9.12	same
24	5.36	3	4.348571	1.786667	9.12	same
25	0	0.75	0.321429	ERR	6.59	ERR
26	0.96	0.75	0.87	1.28	9.12	same
27	3.44	3.5	3.465714	1.017442	6.59	same
28	2.96	0.6875	1.986071	4.305455	9.12	same
29	0.56	0.25	0.427143	2.24	9.12	same
30	0.56	0.5	0.534286	1.12	9.12	same
31	0.56	0.6875	0.614643	1.227679	6.59	same
32	3.76	0.5	2.362857	7.52	9.12	same
33	1.36	0.6875	1.071786	1.978182	9.12	same
34	2.16	0.1875	1.314643	11.52	9.12	changed
35	3.2	0.25	1.935714	12.8	9.12	changed
36	3.04	1.5	2.38	2.026667	9.12	same
37	2.64	1.25	2.044286	2.112	9.12	same
III.	185.36	82.25	141.17	2.253617	9.12	same

Question	Variance	Variance	Variance	f	fCrit	Result
38	2.96	2.6875	2.843214	1.101395	9.12	same
39	2.16	0.5	1.448571	4.32	9.12	same
40	2.64	0.25	1.615714	10.56	9.12	changed
IV.	19.84	7.1875	14.4175	2.760348	9.12	same
41	2.16	0	1.234286	ERR	9.12	ERR
42	2.96	1.6875	2.414643	1.754074	9.12	same
43	2.4	2.1875	2.308929	1.097143	9.12	same
44	4.24	0.666667	3.048889	6.36	19.3	same
45	2.8	3.1875	2.966071	1.138393	6.59	same
V.	27.04	19.1875	23.67464	1.409251	9.12	same
46	2.8	4.25	3.421429	1.517857	6.59	same
47	1.2	0.6875	0.980357	1.745455	9.12	same
48	2.4	5.1875	3.594643	2.161458	6.59	same
49	3.2	0.6875	2.123214	4.654545	9.12	same
50	3.76	2.1875	3.086071	1.718857	9.12	same
51	1.84	1	1.48	1.84	9.12	same
52	4.64	0.5	2.865714	9.28	9.12	changed
53	3.76	0.5	2.362857	7.52	9.12	same
54	2.96	0.6875	1.986071	4.305455	9.12	same
VI.	122.16	74.6875	101.8146	1.635615	9.12	same
Total	2020.16	1726.25	1894.199	1.170259	9.12	same

Appendix K. Comparison of Group Change Results

Question	Treatment Average	Control Average	t	tcrit	Result
1	-0.6	0.5	-1.53292	2.36	same
2	-0.6	0	-0.69007	2.36	same
3	-1.2	0.25	-1.44782	2.36	same
4	-0.8	1	-2.25176	2.36	same
5	-0.4	-0.5	0.220136	2.36	same
6	0.4	-0.75	1.632156	2.36	same
7	-0.8	0.5	-1.54663	2.36	same
8	-0.2	-0.5	0.558394	2.36	same
9	-0.6	0.5	-2.38463	2.36	changed
10	0	0.25	-0.42579	2.36	same
11	-0.6	-0.33333	-0.51602	2.45	same
12	-0.2	0.5	-1.59663	2.36	same
13	0.4	0	0.325779	2.45	same
14	-0.4	0	-0.98601	2.36	same
15	-0.6	0.25	-0.70956	2.36	same
16	-0.2	1.25	-1.47159	2.36	same
17	-0.4	-0.5	0.138494	2.36	same
I.	-6.6	2.75	-1.71526	2.36	same
18	-1	-0.25	-0.92791	2.36	same
19	-0.6	-0.25	-0.41391	2.36	same
20	-0.8	-0.25	-0.58388	2.36	same
21	-0.6	1	-1.47677	2.36	same
22	-0.8	0.25	-1.26	2.36	same
II.	-3.8	0.5	-1.13981	2.36	same
23	-0.6	-1.75	1.109149	2.36	same
24	-1	-0.25	-1.30189	2.36	same
25	-0.2	0.25	-1.6185	2.36	same
26	-0.8	0	-1.00078	2.36	same
27	0.2	0.25	-0.04121	2.36	same
28	-1	0	-2.20479	2.36	same
29	-0.8	0.25	-1.27787	2.36	same
30	-1	0	-1.57135	2.36	same
31	-0.8	-0.25	-0.8854	2.36	same
32	-0.6	-0.25	-0.36476	2.36	same
33	0.2	0.25	-0.072	2.[illegible]	same
34	-0.4	-0.5	0.099507	2.36	same
35	1	0	1.106728	2.36	same
36	1	1	0	2.36	same
37	0.8	1	-0.29943	2.36	same
III.	-4	0	-0.65524	2.36	same

Question	Average	Average	t	tcrit	Result
38	1	0	0.742708	2.36	same
39	0.4	0.25	0.210186	2.36	same
40	-0.4	0.25	-0.64861	2.36	same
IV.	1	0.5	0.224079	2.36	same
41	0.4	0.75	-0.7812	2.36	same
42	0.4	-0.25	0.844174	2.36	same
43	0.4	-0.25	0.782903	2.36	same
44	1	1	0	2.45	same
45	0	0.5	-0.51699	2.36	same
V.	1.2	0.75	0.188552	2.36	same
46	1.2	1	0.155781	2.36	same
47	2	0	3.142697	2.36	changed
48	1	0.5	0.404651	2.36	same
49	1	-0.5	1.725898	2.36	same
50	2	0.5	1.519944	2.36	same
51	1.4	0.25	1.611423	2.36	same
52	-0.4	-1.75	1.024268	2.36	same
53	0.4	-0.25	1.027717	2.36	same
54	0.8	-0.25	0.96537	2.36	same
VI.	9.4	-0.5	1.84227	2.36	same
Total	-2.8	4	-0.38654	2.36	same

Appendix L. Comparison of Group Change Variance

Question	Treatment Variance	Control Variance	Pooled Variance	f	fCrit	Result
1	1.44	0.75	1.144286	1.92	9.12	same
2	1.44	2	1.68	1.388889	6.59	same
3	3.76	0.1875	2.228929	20.05333	9.12	changed
4	1.36	1.5	1.42	1.102941	6.59	same
5	0.24	0.75	0.458571	3.125	6.59	same
6	1.04	1.1875	1.103214	1.141827	6.59	same
7	2.56	0.25	1.57	10.24	9.12	changed
8	0.56	0.75	0.641429	1.339286	6.59	same
9	0.64	0.25	0.472857	2.56	9.12	same
10	1.2	0.1875	0.766071	6.4	9.12	same
11	0.64	0.222222	0.500741	2.88	19.3	same
12	0.56	0.25	0.427143	2.24	9.12	same
13	4.24	0	2.826667	ERR	19.3	ERR
14	0.64	0	0.365714	ERR	9.12	ERR
15	5.44	0.1875	3.188929	29.01333	9.12	changed
16	1.76	2.6875	2.1575	1.526989	6.59	same
17	1.84	0.25	1.158571	7.36	9.12	same
I.	97.04	24.6875	66.03179	3.930734	9.12	same
18	2.4	0.1875	1.451786	12.8	9.12	changed
19	2.64	0.1875	1.588929	14.08	9.12	changed
20	2.56	1.1875	1.971786	2.155789	9.12	same
21	3.44	1.5	2.608571	2.293333	9.12	same
22	2.56	0.1875	1.543214	13.65333	9.12	changed
II.	52.16	4.25	31.62714	12.27294	9.12	changed
23	1.04	4.1875	2.388929	4.026442	6.59	same
24	0.4	1.1875	0.7375	2.96875	6.59	same
25	0.16	0.1875	0.171786	1.171875	6.59	same
26	1.36	1.5	1.42	1.102941	6.59	same
27	2.96	3.6875	3.271786	1.245777	6.59	same
28	0.8	0	0.457143	ERR	9.12	ERR
29	1.36	1.6875	1.500357	1.240809	6.59	same
30	1.2	0.5	0.9	2.4	9.12	same
31	1.36	0.1875	0.8575	7.253333	9.12	same
32	3.44	0.1875	2.046071	18.34667	9.12	changed
33	1.36	0.6875	1.071786	1.978182	9.12	same
34	2.24	2.25	2.244286	1.004464	6.59	same
35	2.8	0.5	1.814286	5.6	9.12	same
36	1.6	1.5	1.557143	1.066667	9.12	same
37	1.36	0.5	0.991429	2.72	9.12	same
III.	62.8	109.5	82.81429	1.743631	6.59	same

Question	Treatment Variance	Control Variance	Pooled Variance	f	fCrit	Result
38	4.8	3	4.028571	1.6	9.12	same
39	1.84	0.1875	1.131786	9.813333	9.12	changed
40	2.64	1.6875	2.231786	1.564444	9.12	same
IV.	12.8	8.75	11.06429	1.462857	9.12	same
41	0.64	0.1875	0.446071	3.413333	9.12	same
42	1.04	1.6875	1.3175	1.622596	6.59	same
43	1.04	2.1875	1.531786	2.103365	6.59	same
44	2.8	2	2.533333	1.4	19.3	same
45	1.2	3.25	2.078571	2.708333	6.59	same
V.	7.76	19.1875	12.6575	2.472616	6.59	same
46	4.16	3	3.662857	1.386667	9.12	same
47	1.2	0.5	0.9	2.4	9.12	same
48	2	5.25	3.392857	2.625	6.59	same
49	2	1.25	1.678571	1.6	9.12	same
50	3.6	0.25	2.164286	14.4	9.12	changed
51	1.84	0.1875	1.131786	9.813333	9.12	changed
52	6.24	0.6875	3.860357	9.076364	9.12	same
53	1.04	0.6875	0.888929	1.512727	9.12	same
54	2.96	2.1875	2.628929	1.353143	9.12	same
VI.	98.24	18.75	64.17286	5.239467	9.12	same
Total	918.16	380.5	687.7343	2.413035	9.12	same

Appendix M. Statistical Analysis

Test 1 - Equivalency of treatment and control groups

Focus Question: Are the treatment and control groups equal in their responses to the 54 questions on the Quality Questionnaire, with 95% confidence.

Assumptions: 1) The population distributions for the responses are normally distributed. This will result in the mean of the treatment group responses (xbar) and the mean of the control group responses (ybar) to also be declared normally distributed for each question.
2) The sampling statistic xbar - ybar is normally distributed as a linear combination of random variables, with its expected value being the true difference in means.
3) The standard deviation of xbar equals the standard deviation of ybar, and is unknown. This equality will be tested in test 2, following. The pooled standard deviation will be estimated, and its difference from the true standard deviation accounted for using the T-test.

Symbols:

xbar	-	treatment group sample mean
ybar	-	control group sample mean
Sx	-	treatment group sample standard deviation
Sy	-	control group sample standard deviation
m	-	treatment group sample size
n	-	control group sample size
Sp	-	pooled standard deviation of sample

Sp = ((m - 1) * Sx * Sx + (n - 1) * Sy * Sy) / (m + n - 2)

Test Statistic:

t = (xbar - ybar) / (sqrt(1 / m + 1 / n) * Sp), with

m + n - 1 degrees of freedom.

Null Hypothesis: Treatment mean equals the control mean

Alternate Hypothesis: The two means are different

The test: Compare t to t critical using a two-tailed test which accounts for a difference in either direction. If the absolute value of t is greater than t critical for alpha / 2 = .025 and m + n - 1 degrees of freedom, reject the null and conclude that the means are different. If not, accept the null and conclude that the means are equivalent.

This statistical test was performed for each of the 54 questions. The t statistic was compared to t critical of 2.36 for m + n - 1 = 8 degrees of freedom at alpha / 2 = .025. The means were then declared to be the "same" or "changed". The results of this test for each question are tabulated in Appendix I. Of the 54 questions, all but one were found the same. This one exception can be attributed to the fact that at the alpha level of .05, even equal populations would be expected to yield unequal samples five percent of the time.

The conclusion of this test is that the treatment and control groups are declared to be equal. This is important in controlling the regression obstacle to internal validity.

Test 2 - Equivalency of treatment and control group variance for Test 1.

Focus Question: Are the population variances of the treatment and control groups equal in their responses to the 54 questions on the Quality Questionnaire, with 95% confidence.

Assumptions: 1) The sampling statistic Sx * Sx / (Sy * Sy) has an F distribution, with its expected value being one if the populations have equal variance.

Symbols:

Sx	-	treatment group sample standard deviation
Sy	-	control group sample standard deviation
m	-	treatment group sample size
n	-	control group sample size

Test Statistic:

f = (Sx * Sx) / (Sy * Sy), or the inverse so that the ratio is greater than one.

Null Hypothesis: Treatment group and control group response variances are equal.

Alternate Hypothesis: The two variances are different

The test: Compare f to f critical. If the value of f is greater than f critical for alpha = .05, with m and n according to the test statistic, reject the null and conclude that the variances are different. If not, accept the null and conclude that the variances are equivalent. This will support the assumption made in Test 1.

This statistical test was performed for each of the 54 questions. The f statistic was compared to f critical of 9.12 for m = 5 and n = 4 and Sx larger than Sy or f critical of 6.59 for Sy larger than Sx at alpha = .05. The variances were then declared to be the "same" or "changed". The results of this test for each question are tabulated in Appendix J. Of the 54 questions, all but four were found the same. These four exceptions can be attributed to the fact that at the alpha level of .05, even equal populations would be expected to yield unequal samples five percent of the time. On two of the questions an ERRor message resulted. This was because one of the variances was zero, resulting in an undefined ratio.

The conclusion of this test is that the treatment and control group variances are declared to be equal. This is important in confirming the assumptions made in Test 1.

Test 3 - Significance of change of treatment group with respect to the control group

Focus Question: Are the treatment and control groups equal in the change of their responses over a 6 month period to the 54 questions on the Quality Questionnaire, with 95% confidence.

Assumptions: 1) The population distributions for the responses are normally distributed. The change in response for the control group, being a linear combination of the pre-test and post-test responses, will then also be normally distributed. This will result in the mean of the treatment group response changes (xbar) and the mean of the control group response changes (ybar) also being declared normally distributed for each question.
2) The sampling statistic xbar - ybar is normally distributed as a linear combination of random variables, with its expected value being the true difference in means.
3) The standard deviation of xbar equals the standard deviation of ybar, and is unknown. This equality will be tested in test 2, following. The pooled standard deviation will be estimated, and its difference from the true standard deviation accounted for using the T-test.

A two sample paired T-test will be used. This is possible because the pre-test can be matched to the post-test for each individual who participated in the quasi-experiment.

Symbols:

xbar	- treatment group sample change mean
ybar	- control group sample change mean
Sx	- treatment group sample change standard deviation
Sy	- control group sample change standard deviation
m	- treatment group sample size
n	- control group sample size
Sp	- pooled standard deviation of sample change

xbar = xbar(post-test) - xbar(pre-test)
ybar = ybar(post-test) - ybar(pre-test)
Sp = ((m - 1) * Sx * Sx + (n - 1) * Sy * Sy) / (m + n - 2)

Test Statistic:

t = (xbar - ybar) / (sqrt(1 / m + 1 / n) * Sp), with

m + n - 1 degrees of freedom.

Null Hypothesis: Treatment mean change equals the control mean change

Alternate Hypothesis: The two means are different

The test: Compare t to t critical using a two-tailed test which accounts for a change in either direction. If the absolute value of t is greater than t critical for alpha / 2 = .025 and m + n - 1 degrees of freedom, reject the null and conclude that the means are different. If not, accept the null and conclude that the means are equivalent.

This statistical test was performed for each of the 54 questions. The t statistic was compared to t critical of 2.36 for m + n - 1 = 8 degrees of freedom or t critical of 2.45 for m + n - 1 = 7 degrees of freedom as appropriate at alpha / 2 = .025. The mean changes were then declared to be the "same" or "changed". The results of this test for each question are tabulated in Appendix K. Of the 54 questions, all but two were found the same. These two exceptions can be attributed to the fact that at the alpha level of .05, even equal populations would be expected to yield unequal samples five percent of the time.

The conclusion of this test is that the treatment and control groups' changes in attitude toward quality are declared to be equal. No significantly different change was observed in the treatment group than in the control group.

Test 4 - Equivalency of treatment and control group variance for Test 3.

Focus Question: Are the population variances of the treatment and control groups equal in the change in their responses to the 54 questions on the Quality Questionnaire, with 95% confidence.

Assumptions: 1) The sampling statistic Sx * Sx / (Sy * Sy) has an F distribution, with its expected value being one if the populations have equal variance.

Symbols:
- Sx - treatment group sample standard deviation
- Sy - control group sample standard deviation
- m - treatment group sample size
- n - control group sample size

Test Statistic:

f = (Sx * Sx) / (Sy * Sy), or the inverse so that the ratio is greater than one.

Null Hypothesis: Treatment group and control group change in response variances are equal.

Alternate Hypothesis: The two variances are different

The test: Compare f to f critical. If the value of f is greater than f critical for alpha = .05, with m and n according to the test statistic, reject the null and conclude that the variances are different. If not, accept the null and conclude that the variances are equivalent. This will support the assumption made in Test 3.

This statistical test was performed for each of the 54 questions. The f statistic was compared to f critical of 9.12 for m = 5 and n = 4 and Sx larger than Sy, f critical of 6.59 for Sy larger than Sx, or f critical of 19.3 for m = 5 and n = 3 and Sx larger than Sy at alpha = .05. The variances were then declared to be the "same" or "changed". The results of this test for each question are tabulated in Appendix L. Of the 54 questions, all but eleven were found the same. These eleven exceptions are more than can be attributed to the fact that at the alpha level of .05, even equal populations would be expected to yield unequal samples five percent of the time. However, this inconsistency is trivialized by the fact that no significant differences were found in the means. Had there been significant findings, the difference in variances may have prompted non-parametric testing of the means, which do not require the assumption of equal variances. On three of the questions an ERRor message resulted. This was because one of the variances was zero, resulting in an undefined ratio.

The conclusion of this test is that the treatment and control group variances may or may not be equal. This is important in confirming the assumptions made in Test 3. However, since Test 3 produced no significant differences in means, the question of equality of variances will not be pursued further.

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APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

A performance management team was implemented at the Engineering Branch of the 2750 Civil Engineering Squadron at Wright Patterson Air Force Base. The team focused on the process of reviewing projects designed by architect-engineer firms and by the Corps of Engineers. As a result of this team effort, improvements to the process were made. More timely and better comments were being provided to the designers after the improvement actions.

From the experiences gained in the analysis of this case, a three day training course was developed. This course was created to provide the tools and mindset needed to begin performance management efforts in other Engineering Branches. The course was designed to provide a starting point, and as a guide to the performance management effort.

The course was structured to be presented at the squadron location, in order to teach people in their own environment. Topics included were the distinctives of the engineering environment, understanding the process framework, the use of measurement in evaluating work processes, and employee participation. The use of the course was encouraged for the base level Engineering Branch.

14. SUBJECT TERMS

Quality Assurance   Productivity   Civil Engineering
Quality Control   Management Training

15. NUMBER OF PAGES
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16. PRICE CODE

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